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BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

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The mobile, 28' scatter antenna pictured on the cover of this issue was furnished by D. S. Kennedy & Co., Cohasset, Mass., and erected on the lawn of Washington's Sheraton-Park Hotel in connection with AFCEA's 12th Annual Convention.

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featuring:

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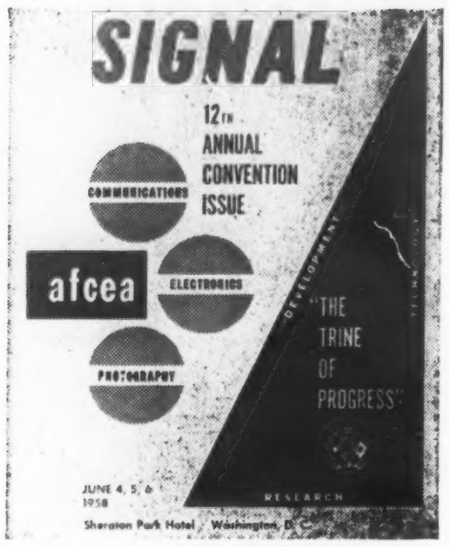
presentations

professional papers



1958 AFCEA NATIONAL CONVENTION HIGHLIGHTS

by W. J. Baird

Editor

JUNE 4, 5 AND 6 MARKED ANOTHER highlight in the progressive history of the Armed Forces Communications and Electronics Association. The twelfth AFCEA Convention, with its theme of "Research, Development and Technology—The Trine of Progress," was top rate and featured many noticeable innovations which made this event the show of shows and definitely better than its predecessors. The skillful layout of the show plus the quality of the exhibits and the enthusiasm of the companies' representatives contributed no end to a refreshing atmosphere. Mr. William C. Copp, of W. C. Copp & Associates, the show manager, whose professional touch was much in evidence, is to be congratulated for his superior management. Especially so when one considers that this year's convention came at a time when recessional trends stood foremost on the nation's calendar of events.

SIGNAL Magazine wishes to express its appreciation to the communications-electronics publications and to the daily press for their excellent coverage of the convention. This, coupled with the NBC broadcast of Alex Dreier's tribute to AFCEA over 200 stations and to a listening audience of 9 million people (see July issue, page 5), stimulated convention interest and contributed to our excellent attendance of nearly three thousand.

National Headquarters recognizes that countless hours of behind-the-scene work set the stage for this smooth running and well-organized show. On behalf of the Convention President, Frederick R. Furth, and the entire membership of AFCEA, the Association wishes to commend the members of the convention committee for their devoted interest and untiring efforts. Those to whom special recognition is due are: Convention Chairman—W. B. Goulett; Convention Vice Chairman—Millard Richmond; Professional Papers—Gordon Caswell; Banquet, Buffet and Luncheon —Ed Girard; Entertainment—John Gilbarie; Transportation—George Sheets; Ladies' Activities—Mrs. Dorothy Christopher; Programs—John O'Brien; Treasurer—Frank Martins; Advisory Group—Percy Black, Francis Engel, Thomas Jacocks and L. Harriss Robinson. Assisting the Editorial Office in Public Relations were: Roland Davies, Herb Rosen and Tom Gootée.

Professional Papers

Rear Admiral Gordon Caswell, as Chairman of the Professional Papers Committee, is to be congratulated for his efficient planning and selection of papers. The response to his request for papers was terrific and his selection, after considerable study and analysis, was outstanding. Gordon also took on the extra job of providing for the high caliber panel presentations which contributed materially to the convention program. Commendably assisting Admiral Caswell as Moderators for the professional papers were: Colonel Daniel H. Harvey and Captain C. L. Engleman.

Ham Radio

A new added star to this year's convention, originated by the ever-active Ray Meyers, West Coast Regional Vice President, was the ham radio station K40FB/3. We are indebted to the Department of the Navy for making the installation at the Sheraton-Park Hotel. Ray Meyers, assisted by a group of ROTC students from Northeastern University, Boston, Massachusetts, manned the station and kept the conventioneers in touch with their home office business activities. Between times, K40FB/3 was in communication with other "hams" around the world.

Ladies' Activities

It was a source of satisfaction to hear the many favorable comments in connection with the Ladies' Activities Program. Under the capable direction of Mrs. Dorothy Christopher, a three-day program of tours, banquets and social meetings was arranged, highlighted by a luncheon and fashion show which was staged by Inga. With a group of attractive models, Inga introduced the latest in hats, beach attire and summer wearing apparel (sponsored by the Hecht Co. of Washington, D. C.). Among the 150 attending the luncheon and fashion show were approximately 50 ladies from out of town. The Association is deeply indebted to Mrs. Christopher, Chairman of the Ladies' Activities Committee, and to her two charming assistants, Mrs. E. Harriss Robinson and Mrs. Thomas Jacocks.

Observations

Another feature of this year's convention worthy of special comment was the excellent caliber of our guest speakers. General Hershey, Mr. McLean and Mr. Powell "carried the message to Garcia." Their presentations challenged the imagination of the audience and brought praise from all hands.

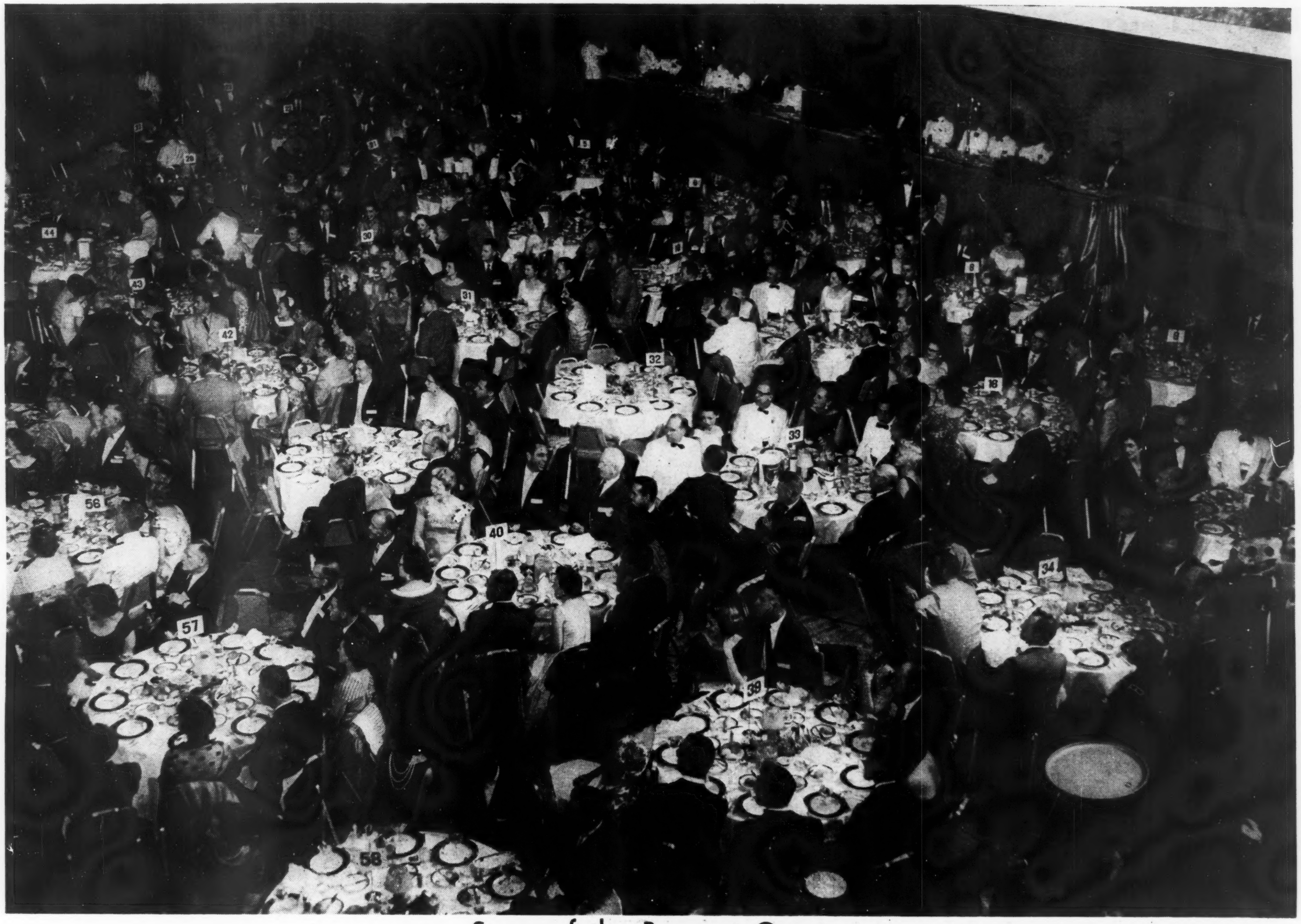
Mrs. Godfrey, Secretary of AFCEA, reports that 65% of the Chapters in the United States were represented at the President's Meeting. Also, well attended was the Council and Directors Meeting at which subjects were freely discussed and a goodly amount of beneficial information exchanged. Members of the administrative and editorial staffs at National Headquarters gave unselfishly of their time before and during the convention. Their contribution and services to the success of the convention were invaluable. Together with the members of Mr. Copp's office, much was accomplished which otherwise would have been most difficult to achieve.

Mr. John Ferguson, Monumental Printing Co. of Baltimore, Md., Mr. Lynn Anderson, D. C. Engraving Co. of Washington, D. C., and Mr. Bill Robinette, Art Consultant of Washington, D. C., rendered valuable assistance and worked very closely with the editorial staff in the preparation of the SIGNAL Convention issue.

Exhibitors And Advertisers

SIGNAL Magazine wishes to express its sincere thanks and appreciation to our exhibitors and advertisers for taking part in the 1958 Armed Forces Communications and Electronics Association Convention and Exhibition.

We want you to know that your participation was a major contribution to the success of the largest electronics show in the nation's capital.



Some of the Banquet Guests

The President's Page

FREDERICK R. FURTH

Some of the Banquet Guests

AS I START MY SECOND CONSECUTIVE TERM OF OFFICE AS PRESIDENT, I DO so with a deep feeling of humility. Precisely so, because there are but a few occasions in life when one is privileged to occupy such a position of prestige as the Presidency of the Armed Forces Communications and Electronics Association.

During the past six months, the Association, like many other organizations and businesses, felt the economic impact of the Nation's recessional trend. Fortunately, we suffered no material setback during this period. This is indicative of the strength of AFCEA and the belief in the aims and objectives of the Association by our group members, chapters and individual members and the subscribers to SIGNAL Magazine. It is my conviction that the year ahead will be one of continuing growth and progress. Each one of you can make your own contribution to this end by taking an active interest in your chapter activities. You can also assist in building up our present membership through personal contact of friends and increase our group membership by informing interested individuals in the fields of electronics, communications and photography of the advantages of AFCEA. Your personal interest in the affairs of the Association is AFCEA's greatest asset.

Having accepted your nomination to serve as President for another year, I feel that the past year has given me a clearer understanding and a deeper knowledge of the responsibilities of this office. I accept the challenge to serve the Association and to carry out to the best of my ability those projects which are of meaningful importance to you.

AFCEA Honors Frederick R. Lack

At the AFCEA Banquet, Frederick R. Lack (left) of Western Electric Company was presented an award by AFCEA National President Frederick R. Furth. The award, presented to Mr. Lack who retired from Western Electric on August 1, reads: ". . . to Frederick R. Lack, Organizer, Charter Life Member, Past President and Director, in appreciation of his twelve years of unselfish devotion to the interests of the Association."

Early arrivals registering on opening day.

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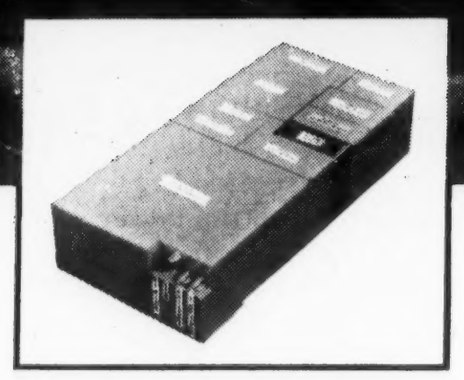
Chapter Presidents' Conference



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The uniqueness of the new NAVTAC en route navigation and instrument landing system by Stromberg-Carlson is in its *combination* of functional modules.

The NAVTAC equipment is an assembly designed to provide high-performance aircraft with the TACAN navigational aid, plus marker beacon receiver, glide slope and runway localizer for instrument landing situations.

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The equipment is designed to meet the rigorous environment of the high-performance aircraft of today and tomorrow. Its operating ambient temperature range is −60 to +125 degrees C. at altitudes up to 70,000 feet. Widespread use of semiconductors in the ILS receivers and TACAN circuitry means high reliability, small size and low power consumption.

Included in the design is the capability of performing complete preflight confidence tests with the use of a small auxiliary test set.

Complete technical details on the NAVTAC system are available on request.

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SOLAR ENERGY AND ITS POTENTIAL APPLICATIONS

by

James D. McLean
Pres., Hoffman Labs.

WHETHER ONE THINKS OF THE Aztec Indians as profound worshipers of the sun or of Archimedes who, in 200 B.C., built concave mirrors for military operations, the fact remains that, historically, man's fascination with the sun is nothing new.

Since the time when Archimedes' mirrors focused the sun's rays and ignited the sails of attacking Roman ships at the distance of a bow-shot, other scientists have studied the wonder and powers of solar energy. Lavoisier, during the reign of Louis XIV, built concentrated lenses to achieve temperatures of nearly 2.000°C. John Ericsson, inventor of the ironclad *Monitor*, designed a solar engine which focussed the sun's rays on a tube to heat air and run a pump.

More recent work in the field includes the 11 hp solar engine, built at the Pasadena Ostrich Farm around the turn of this century, which was capable of pumping 1400 gallons of water per minute. The largest solar plant ever built, one with 100 hp capacity, was operated successfully near Cairo, Egypt, just prior to World War I.

Under direct sunlight, approximately 1 kw of solar energy falls on each square meter of earth's surface. To illustrate what this means, the sunlight falling on Lake Mead in one day is five times the output of Boulder Dam for twenty-four hours. Or, even more graphic, three days of sunlight on the earth equals the total energy of all the stored fuels throughout the universe. The significance and future application of solar energy becomes ever more meaningful when one considers the fact that the population of the earth is increasing at a tremendous rate (expected to triple in the next century), and the power consumption per capita is increasing as technology advances. At the same time, the fossil fuels (coal and oil) are being depleted at an alarming rate.

The recent harnessing of atomic energy may offer one bright spot. However, at present it is useable only in large quantities (such as operating power plants), and it has the ever-present danger of radioactivity. In addition, atomic fuel, too, is limited and may eventually run out.

Types of Conversion

To appreciate the possibilities of solar energy and its future application, we must consider the problem of converting this energy into useful purposes. Work has been done in the conversion of solar energy directly to all other forms of energy—mechanical energy, chemical energy, electrical energy, etc. Let us discuss this briefly.

• Photo-Mechanical Conversion: Many of the devices just mentioned operate by means of conversion of the light energy of the sun into mechanical energy, such as the solar engines, pumps, etc.

• Photo-Thermal Conversion: Much progress has been made in recent years in the area of converting solar energy into heat. The basic principle of this is best illustrated by the greenhouses in which plants can be grown all year around. Essentially, the light rays can penetrate the glass, but when reflected back in the form of longer heat waves, they do not penetrate the glass. This is the reason a car which has been standing in the sun, is much hotter than the surrounding air.

This same principle is used in solar heating of houses, such as have been built at MIT, the first completely solar-heated office building in Albuquerque, New Mexico, and the just-completed solar house at Scottsdale, Arizona.

Another method of photo-thermal conversion is the solar cooker and solar furnace. In these, parabolic mirrors focus the sun's rays at a single point to create intense heat. The simplest form of these is illustrated by a product which is on the market, called "Umbroiler," which looks like an inverted umbrella and which provides campers with a method of cooking meals. The largest solar furnace, located at Mont Louis in the French Pyrenees mountains has a reflector 35 feet in diameter made up of 3,500 small flat mirrors and is capable of generating heat equal to 75 kw of power and can melt more than 200 pounds of metal at a time. These solar furnaces can also be used in high temperature metallurgical studies since they produce pure heat, uncontaminated by the burning fuels.

• Photo-Chemical Conversion: The best known method of converting solar energy into chemical energy is nature's own process of photosynthesis, by which plants grow. Scientists of many countries, most notably Japan, have been working to augment this process by the culture of chlorella, or algae (a low form of plant life), which requires only water and carbon dioxide to grow, and which yields several times as much food value as soil-grown crops. Much remains to be learned about this, but it holds promise as an important way of easing the world's food shortage.

• Photo-Electric Conversion (with which Hoffman is most concerned): Early experimenters in this area worked with the principles of thermo-piles, photogalvanic cells, and photovoltaic cells. The latter we are familiar with as it is the principle used in the photographer's light meter. However, it uses a selenium cell which operates at only about 1% efficiency, enough to move the needle on the meter, but hardly enough to be utilized as a power source.

In 1953, Drs. Chapin, Fuller and Pearson, of the Bell Telephone Laboratories, in work arising out of the development of the transistor, discovered that they could reach conversion efficiencies of 6% by use of silicon junction devices. In late 1954, the Semiconductor Division of Hoffman Electronics Corporation, in Evanston, Illinois, put these cells into commercial production. By the end of 1956, efficiencies of 10% were being obtained from regular production cells, and efficiencies of 13% under laboratory conditions. Clearly these were useable amounts.

Description of a Silicon Solar Cell

How are silicon solar cells made? Basically the following steps are involved in the production of silicon solar cells.

• The basic ingredient is silicon, which we all know as one of the elements of sand; however, it is a long

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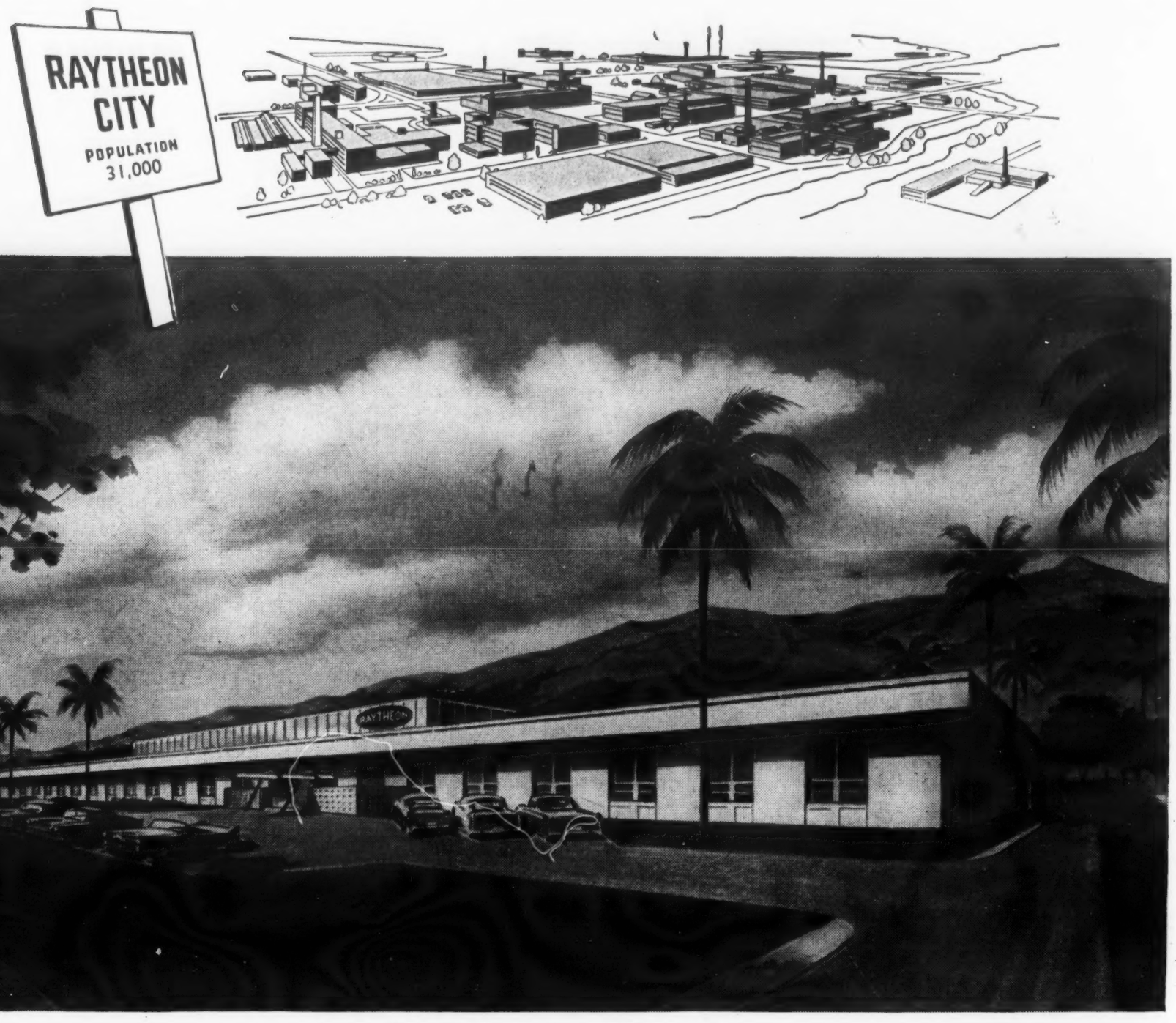

NEWEST ADDITION TO RAYTHEON "CITY"

Increases company's engineering space to 903,000 sq. ft.

Raytheon's brand new laboratory at Santa Barbara, California, is devoted to advanced engineering in radar, countermeasures, communications, infrared. It's another extension of Raytheon "City"—the booming electronics community that has grown from Massachusetts to Tennessee to California.

Here are the company's vital statistics:

POPULATION: 3,000 scientists and engineers; 31,000 employees in all.

BUILDINGS: 26 plants and laboratories.

WORK AREA: 903,000 square feet of engineering space; 4,104,827 square feet of total space.

ACTIVITIES VITAL TO NATIONAL DEFENSE: Missiles—Navy Sparrow III and Army Hawk; bombing radar for the B-52; DEW line radar; tubes, transistors; magnetrons, amplitrons, klystrons and backward wave oscillators.

REPUTATION: World-wide.

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and expensive journey from this abundant material to a solar cell.

• The silicon must be extracted from the sand and purified to an exacting degree. Impurities present must be less than one part in one million parts of silicon. This is an expensive process and we buy this hyper-pure silicon from Du Pont for approximately $100 a pound.

• The "chunks" of this hyperpure silicon are then placed in a quartz crucible in a specially controlled atmosphere furnace and heated to approximately 2,000°F, at which heat it melts.

• After the silicon is melted, it is "contaminated" with a minute quantity of arsenic, which is mixed in with the molten silicon.

• A "seed" of silicon in single-crystal form is then lowered into the molten silicon and withdrawn at a rate of about 1 inch an hour. When the rate of withdrawal and the temperature of the molten silicon is held to the exact requirement, the molten silicon will form on the seed in the exact crystalline form of the seed and will result in a single crystal being "grown." This process takes about four hours and yields a single crystal about 4 inches long and one inch in diameter.

• A diamond saw is then used to slice this ingot into wafers 16/1000 of an inch thick. The thickness of the saw causes about half the crystal to be lost in the form of dust.

• The slices are then placed in a diffusion furnace which heats them to just below the melting point. At this time, boron gas is introduced into the furnace. At the furnace temperature, the boron diffuses into the silicon to a minute depth which is controlled by the length of time the cell is in the diffusion furnace.

• After cooling and removal from the furnace, the back side of the cell is etched with acid to remove the boron coating.

• The back side and the edge of the front side are then plated with nickel to form the negative and positive terminals respectively. The cell is then completed.

*Principle of Operation**

In the interest of editorial space, I will not go into a complete discussion on what makes the solar cell work. Briefly, the cell, when exposed to light, undergoes a reaction which builds up an external voltage on the device and, if a load is connected across the two connectors of a cell, a current will flow through the load. The light thus acts as a current generator and, since nothing has been added to or removed from the silicon, the process can continue as long as there is light available.

Power Output

• A single S-2 cell will generate about 40 milliwatts (100 milliamps at .4 of a volt) under direct sunlight.

• A single 120-C cell will generate about 17 milliwatts (42 milliamps at .4 of a volt) under direct sunlight.

• Similar to a battery, connecting solar cells in series increase the voltage and connecting them in parallel increases the current.

Applications

Basically, the areas where solar cells hold promise are those in which an unattended power source is desired in a location which has no other source of electricity available. In general, they would be used in conjunction with a rechargeable storage battery to provide a continuous power source day or night. Nickel-cadmium batteries, a sealed wet cell, appear the most attractive at the present time.

A. *Low-power applications*

• Flashlight—Hoffman has made small quantities of these for evaluation by both the Signal Corps and the Navy. In these, rechargeable Gould batteries store up the power for use at night. Approximately 5 hours of sunshine provide enough power for one hour of continuous use at night. In the case of the military, where there is always a supply problem, even of batteries, they may prove valuable. In addition, there may be a market for them among campers, etc.

• Highway flasher—In this application, storage batteries again store the electricity for use at night. These may prove useful for highway construction work or possibly for marking emergency runways on an airstrip.

• Palm Springs clock—Due to the low power drain of d.c. clocks, solar cells are easily able to keep a clock in continuous operation.

• Solaradio—Already on the market is the solar-powered radio, being made by Hoffman's Consumer Products Division, which contains solar cells in the handle. The radio contains 4 Gould penlight-size rechargeable batteries which charge during the day or under an incandescent lamp, and play on about a one-to-one ratio of charging to operating. The radio will also operate directly off the solar cells.*

B. *Medium-power applications*

• Santiago Peak converter—This past fall, Hoffman completed 4½ months of successful operation of a radio repeater station atop Santiago Peak in Southern California. In this installation, a receiver-transmitter was powered by batteries kept in a charged state by a large solar energy converter consisting of 504 solar cells. The installation was maintained on a U. S. Forest Service lookout tower and pointed the way towards one of the potential uses of this type of converter.

The automatic repeater station consisted of, in addition to the solar energy converter, a 12-volt rechargeable battery to store the electricity for use when the sun was down, and a transistorized radio receiver-transmitter. It was set up to listen to all messages on the Forest Service's Cleveland National Forest Network and repeat these in the form of an audible tone to a monitor in the Hoffman plant in Los Angeles, some 50 miles away. This converter produced as much as 125 watt-hours of electricity per day.

• Coast Guard converter—Another test of a solar energy converter is currently in progress at the Los Angeles Harbor Lighthouse by the U. S. Coast Guard. Here the solar cells are supplying power for a flashing light in a test designed to evaluate the cells in operating harbor navigational aids or channel markers. This installation necessitated the addition of a sea gull deflector on top of the converter, but our engineers think of everything.

• South Africa—Hoffman has also sold two converters to the government of the Union of South Africa for evaluation for use in remote telephone lines in that country. An application such as this has also been tested by Bell Telephone in its installation at Americus, Georgia.

• Satellites—Perhaps the most obviously inaccessible location and one in which solar cells are already proving their worth is in space satellites. The Navy's Vanguard satellite, now circling the earth, contains Hoffman solar cells, which supply power to its radio transmitter (a second transmitter on the Vanguard, powered by conventional batteries, was silenced a few weeks after it was placed in orbit). The cells were encapsulated for their application in the Vanguard by a team of scientists at the U. S. Army Signal Engineering Laboratory at Fort Monmouth, New Jersey, under the direction of Dr. Hans K. Ziegler. There are six solar batteries, each containing 18 cells, distributed over

(Continued on Page 26)

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*Anyone interested in the basic operation of the solar cell may write SIGNAL Magazine.

*A new Hoffman solar-powered radio receiver, soon to be on the market, will retail for $75.

Message From The Executive Vice President

"BILL" B. GOULETT

FROM WHAT I SEE, HEAR, AND READ, I judge that the 1958 Convention was notably successful. But there are numerous, usually smallish items that invite change; the Chairman and his committee will be alert and pliable in arranging for better things next year and encourage your sending in comments and recriminations of any kind whatsoever.

As would be expected, programming can be improved; for example, we may decide to have panel discussions exclusively next year instead of professional papers. We shall continue to strive for *quality* in all phases of the next Convention, which, incidentally, is scheduled for the first week in June at the Sheraton-Park Hotel in Washington. There is no substitute for *quality*, and we shall not trifle with our principles.

The Chapter Presidents' Meeting of June 4th, a rousing event, brought forth enthusiastic and comprehensive views from all segments of the Chapter Kingdom. It was spirited during its two-to-three-hour length. Chapter personnel speak highly of its benefits.

Then on June 5th were the Directors' and the Council Meetings, which appeared to merge as one large gathering, wherein AFCEA business matters of current importance received a good going-over, and the regular annual election of officers took place (the results were announced in the July issue), the slate having been presented by the Nominating Committee Chairman, Ted Bartlett. President Furth skillfully guided all the official meetings.

The social-professional events—the banquet and the buffet with their receptions, the Keynote and the Industrial Luncheons—were generally so well received that the Convention Committee will think long before leaving any one of these off the next program.

Very often I am asked: Why must Washington have the AFCEA Convention? Why not give other sections of the country—or the world—a chance? These good, fair questions are so universal that National Headquarters must respect them always. Unquestionably there is a great advantage in a policy of "showing the flag" in different AFCEA areas in order to further the aims and increase the prestige of those areas as well as of AFCEA as a whole. But we find there are compelling, almost unchangeable factors that make the Executive Committee vote "yes" on the National Capital site: (a) National Headquarters, with its increasing convention lore, can handle the sizeable convention chores without having to saddle a recognizably inexperienced and modestly funded chapter with such responsibilities. (b) Washington has time-proved facilities, especially at the Sheraton-Park Hotel, which specializes in conventions and can handle well over a hundred exhibits. Few other cities can handle such exhibits. (c) Though a purely East Coast city, the National Capital can bring in more representatives of industry and of the Armed Forces than any other known place, because of the existence of so very many military agencies and company branches, all of which are active in AFCEA's fields. (d) Circumstances that reek of money are not popular in convention thinking, but the fact remains that in large measure National Headquarters depends for its maintenance on Convention-obtained funds. And Washington conventions are proved money-makers. (e) Effective management of conventions, especially in the exhibits, requires essentially professional services, with oiled machinery for involved promotion efforts. Here we need the skill and cunning of the "old pro."

Planning and running a convention are ulcer-encouraging labors, but there is reward in many ways not connected with dollars. Not the least heart-warming is the realization that the convention brings together important citizens whose problems are common and who benefit by knowing each other.

On behalf of the Committee and AFCEA as a whole, I thank you all for your support. Come again—the first week of next June!!

Respectfully and Cordially,
W. B. (Bill) Goulett,
Chairman

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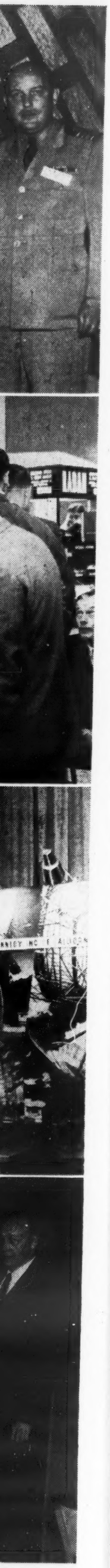

Mr. Powell, who addressed the Keynote Luncheon, is a member of the staff of The Honorable Perkins McGuire, Assistant Secretary of Defense (S. & L.). He specializes in the field of industrial mobilization planning, with particular reference to industrial preparedness.

MARK TWAIN ONCE SAID ENGLAND and the United States were two nations separated by a common language. Much the same thing could be said about Washington and the rest of the United States. However, I will try to speak United States instead of Washingtonese.

My subject has been called "The Collapse of Time." It could have been called from "Muscles to Missiles" or "Adam to Atom."

To begin on this subject you have to determine some new concepts of time and some new concepts of money. If most of you don't think that your present concepts are obsolete, I hope by the time I'm through you will be thoroughly convinced that very many things are obsolete. Let us start with the concept of time.

Most of us are very much handicapped by a very obsolete concept of time. We think it is a measure instead of a dimension! There have been 50,000 years of mankind's history. No one can visualize 50,000 years. Even those people who went to school with me (who aged much faster and are now middle aged) can't visualize 50,000 years. So let's compress history to 50 years, which most of us can understand. If the whole history of mankind had happened in 50 years, what would have happened and when would it have happened? If all mankind's history had happened in your lifetime what would have happened and when? Well, this is it: ten years ago you would have stopped being a cave man; five years ago the smartest man here might have invented some kind of pictorial writing; two years ago Christianity would have appeared on the scene; fifteen months ago you would have had the printing press; twenty days ago, electricity; eighteen days ago, the airplane; ten days ago, radio, and four days ago, TV.

Now, since we have enough difficulties at the moment, I have altered this history a little bit so that "Rock and Roll" would not yet have happened! Also, the jet airplane would have been invented since I began this article. Now, so much for time. Let us formulate some concepts concerning money.

When I was a kid, the word million was reserved for just three things, dandruff, bacteria, and John D. Rockefeller. Today it is used commonly in business and we even use the term billion in Government.

What is a billion? Can anybody visualize a billion? If you started counting the day you started talking, could you count a billion in a lifetime? Let us get a perspective on a billion. A billion is just about the number of minutes in a Christian era. If you started at the year zero AD and counted up the minutes, you would now have come to within a few percent of a billion. When you talk about a defense budget of 40 billion dollars, you are talking about approximately $40.00 per minute since the beginning of the Christian era. If you want to put it another way, it is more than $1,000 per second, and more than 100 million dollars per day. This is the premium on your defense policy.

Many ask: "What makes war cost so much?" The standard answer is: "War has gone technological." Let's put this into some interesting examples. If you are in the restaurant business and you serve 10,000 meals a day, you are a big time operator. On the other hand, if on any day you served only 9,999 meals to a full crew, on board the *Forrestal*, some mother would complain to her senator that her boy got sent to bed without any supper.

Consider some more examples: The B-52 is a pretty important airplane; it is a pretty heavy airplane. However, I wonder how many of you realize that it cost more than its weight in silver. The clothes a gentleman wears weigh between 8 and 11 pounds, depending on whether they have their longies on. Sir Lancelot went into battle with 88 pounds of armor whereas a jet pilot takes 144 pounds of equipment. Those of you that have been on a modern carrier know that we have a moving stairs to get pilots up to the flight deck so they won't be exhausted when they climb into the plane.

The B-17 was a pretty important plane in World War II. Some of you undoubtedly flew them and some of you undoubtedly flew in them. If you take all the engineering manhours that were spent on all the B-17's that were ever built, you would not have enough engineering manhours to build one B-52.

To prepare for the next time you hear about the carrier *Forrestal* and you hear that it is a big ship, let us get some perspective on it. If it came down the main street of most towns in America, there would only be a handful that would have a building as tall as it. It is 25 stories tall! The next time you recall that the American luxury liners, the *Independence* and the *United States* are the two biggest luxury liners that we own, just remember that we can put

them side by side on the deck of the *Forrestal.*

You read a lot about missiles nowadays. I'm not going to bore you with details, but I want you to read just a little bit from *The Military Engineer* about one of the very elemental types. The complexity of a Nike system may be visualized from the following statistics: It contains approximately 1,500,000 parts, 217,000 feet of conductor wire, 2,000 feet of coaxial cable, 2,000 electron tubes, 12,000 resistors and 5,000 capacitors, 460 relays, 1,250 coils, etc.

I'm sure that some of you remember when Lindberg crossed the Atlantic. The next time you think of Lindberg's powerful plane that went for 30 continuous hours from New York to Paris, just remember one thing. If that engine had a little more power, we could use it for a starter on a modern jet!

Now having discussed war as having gone technological, let's take a look at where technology has really gone.

Speed

Let's go back to Nero's time to consider mankind's technical progress. We'll take as an index of man's progress the speed at which he can travel. Speed is a fairly good index of technological progress. If you are in a country that has ox-cart transportation, that's a pretty good index of the technology of the country. The same thing is true if they have railroads or DC-7's.

How fast could a man go in Nero's time? He could go as fast as a horse could carry him or pull him, and no faster. Through the 47,000 years of man's previous history there has been little deviation. Man would have still gone only as fast as a horse could carry him or pull him—up until 128 years ago. If Nero had a horse that could do 35 miles per hour, he had an oatburner that was indeed a winner!

Moving through history, let's go ahead 15 centuries from Nero to where Columbus discovered America. How fast could man travel in Columbus' time? Whether he was the richest or the poorest man in the world made no difference. He could travel as fast as his horse could carry him, and no faster.

Now let us go ahead to the year of 1776. It is a very historical year! Every school boy knows that this was the year when Paul Revere made Longfellow famous. So, in Paul Revere's time history depended on the speed of an oatburner. American history could be made no faster than Paul Revere's horse could gallop.

In 1830 a tremendous thing happened. Unfortunately, there wasn't a good journalist around to report it. This is the year when man broke the "oat barrier" for the first time in 49,800 years. Man could move faster than the muscles and the digestive system of an animal. The iron horse came into existence. Now we're on the upswing.

In 1910, we bought the first military airplane. The contract provided that the plane must do 40 miles per hour or the contractor was to be discounted for each mile under 40—ten percent off for 39 and another 10 if he only made 38. For the taxpayers' benefit, this first airplane met every single term of the contract, making the incredible speed of 42 miles per hour.

Around World War I, there were some speeds of 100 miles per hour—Ralph DePalma on the racetrack, and the Reading Railroad from Philadelphia to Atlantic City. Towards the end of World War I we had some speeds of 150 m.p.h. At the beginning of World War II, 200 miles per hour was "speed" and at the end of World War II the fantastic speed of 470 miles per hour was top secret, but it had been done.

Then something marvelous happened. It was discovered that we didn't have to make progress the hard way. We didn't have to plod.

1945—The Big Year

Why not substitute inspiration for perspiration? All of a sudden in 1945, we started making more progress in a week than we had previously made in a year. Speed zoomed up to 470 m.p.h. and blasted through the sound barrier. The sound barrier was merely an incident. Breaking the oat barrier was the beginning of technology.

A year ago the highest possible speed was 1,600 m.p.h. Today with Sputniks, Explorers, Vanguards we are talking about the speeds of 18,000 m.p.h. and space travel.

This speed all started to happen in 1945. It has happened so fast that people can't visualize it. In September 1956, we had a navy plane flying over Long Island. The fellow fired his guns, and forgot to change his course, with the result he overtook his own bullets and shot himself down.

When we released the story to the press, it aroused about as much interest as how to take a grass stain out of a linen dress. It simply wasn't grasped by the American public. Commercial aviation has arrived at the incredible position on commercial flights where you can now go from here to the west coast in about half the time it takes you to get your baggage after you get there.

Notice 1945; this was the year of the big change. This is the year in which somebody threw away that world you used to live in. The world's dimensions were drastically changed so smoothly that most people don't realize that they are now living in a different world. Many of our concepts and our organizations have been bypassed by progress.

Explosives

Let's go back and consider explosives. They started with the ancient Chinese invention of gunpowder. Passing through the years, there was achieved a bigger explosion by making a bigger pile of powder. Then there came the TNT's, the nitroglycerine, the triple base explosives and all the rest of the plodding progress. We came all the way through World War II with what we thought was progress. Suddenly in 1945 somebody invented the "A" Bomb. This makes all previous explosive forces so ridiculous that you don't even have a suitable unit of measurement. A ton of TNT equivalent used to be a unit of measure.

A block buster, the biggest thing we had in World War II, was the equivalent of six tons of TNT; that was its rating. Along comes the "A" Bomb and a ton of TNT is about as useful a measure as an inch is to measure the distance from here to Hawaii. We must invent another word. So the boys invented the word "kilotons," meaning a thousand tons of TNT. But before anybody could write it, without having to look up how to spell it, somebody invented the "H" Bomb which made the kiloton relatively obsolete. A kiloton now was as useful a unit of measure as ounces to weigh elephants.

Now, you measure an "H" Bomb or nuclear devices in terms of megatons. How much is a megaton? One megaton is the equivalent of 1,000,000 tons of TNT. This is not the size of a bomb—It is the unit of measurement. Now, how big is a megaton? Well, if you take a freight car 50 feet long with a 50-ton capacity and you started loading every car to capacity and keep adding cars, when you had the other end of that freight train 200 miles away you have on board one megaton.

Now, if you want to put this in terms of World War II, take the block buster bomb. This was the biggest thing we had in World War II.

(Continued on Page 22)

NAVY'S NEW ATOMIC DEPTH BOMB ANSWERS THREAT OF ENEMY SUBS

THE NEWS THAT "BETTY" is now an operational weapon completes another chapter in the story of the Navy's great contributions to the defense of our country. And we are proud that the Navy Bureau of Ordnance and the Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland, developers of this significant weapon, called upon the facilities of AMF for the production of "Betty". This is another demonstration of the fact that, when it comes to the tough jobs, AMF has experience you can use.

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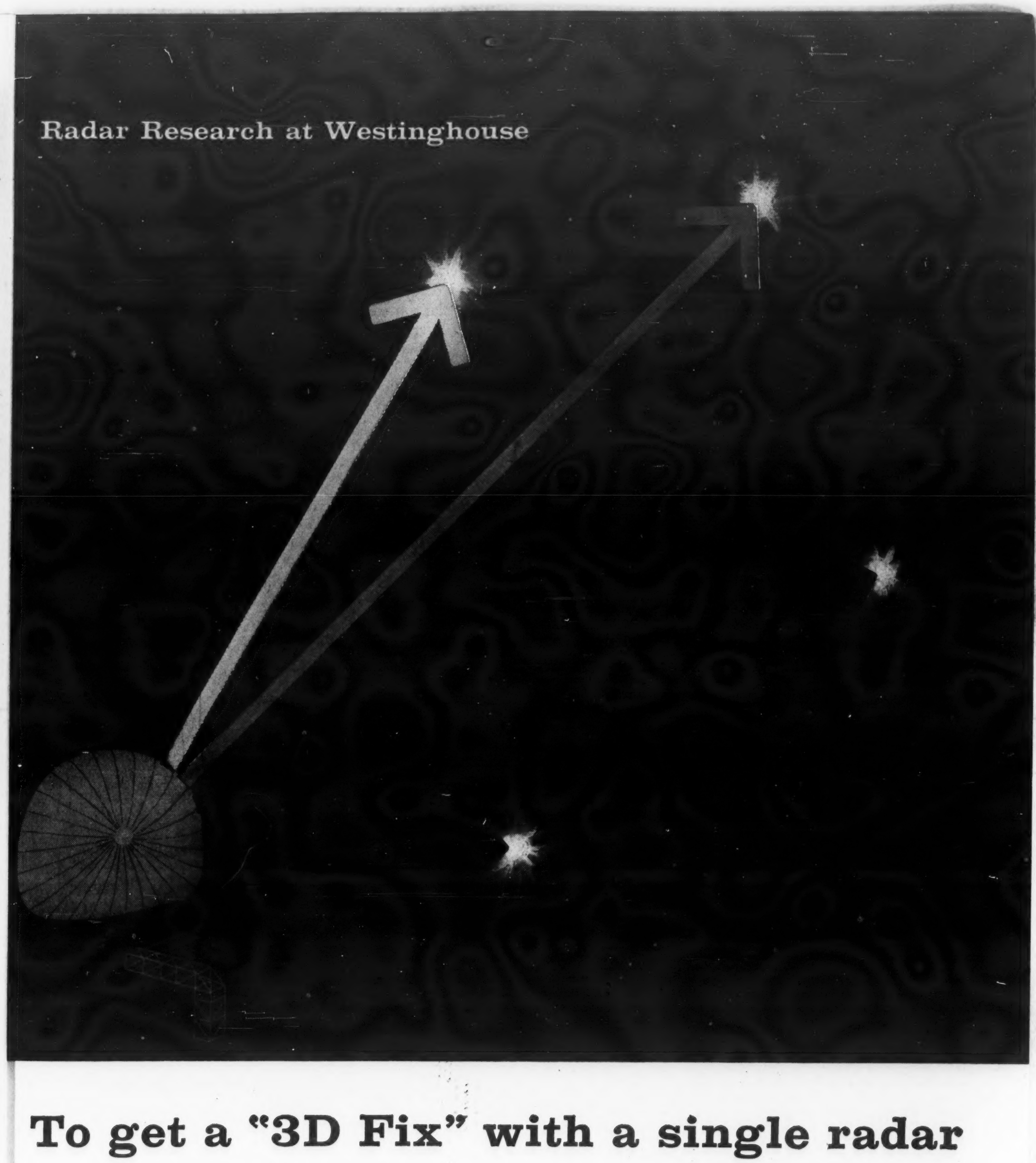

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Powell

(Continued from Page 18)

If you had 166,000 of them you still wouldn't quite have a megaton.

You can go all the way back to the Bible on this one, because David was the boy who invented missiles. Goliath should have won that debate by every rule that was then in the book. However, David invented mechanized warfare and proved that one boy throwing a pebble a few yards with a sling shot could lick a giant with a club. Next in importance came the Roman catapults, etc., until the arrival of cannon balls in Paul Revere's time. From there we proceed to World War I.

During World War I we were talking of ranges in the neighborhood of 20 to 30,000 yards. Come up to World War II where you were talking about 60,000 to 80,000 yards as a real big deal. Then exactly at the same period in 1945, new progress makes all previous progress seem picayune. The Germans started out with the V-2 rendering a yard an obsolete measure, even 100 yards or even 1,000 yards. We started using miles —rapidly progressed beyond hundreds of miles, and people are now using the term intercontinental as a term of measurement.

Why all this skyrocketing progress started in the year 1945 is anybody's guess. Consider medicine. If you have been to the drug store to get a prescription filled in the last year, I'm willing to bet you 8 out of 10 that the medicine wasn't even invented 10 years ago, that your doctor never heard of it when he went to medical school, and neither did the pharmacist who filled this prescription. You now get one major medical break through every six months.

Population

Let's consider the progress of population. This is a fascinating question if you consider this land of ours from ocean to ocean, and border to border—at one time it supported 1,000,000 Indians. Now the Indians were a very primitive people. They did not know how to pollute the streams, they were too unskilled to waste the top soil, they hadn't yet learned how to burn the forests. So they had unlimited resources. However, they did frequently starve between famines. Since we are more civilized, we have washed the top soil down the drain; we have burned the forest and we have polluted the streams. *But* we have 172,000,000 people living on this same land where Indians starved.

We have 8,000 more for breakfast every morning, 240,000 native born new citizens every month. We enjoy the highest standard of living in the world and we are the only nation on earth that is plagued by surplus. It is a grim fact that two-thirds of the world goes to bed hungry every night and in America you beat your kids to make them eat.

What is it that we have that these Indians didn't have? Certainly it isn't resources! It is a complex matter and yet a simple one. We have three interrelated factors—democracy, technology, free enterprise. You can't argue which one is the more important.

Let's take a look at what this combination of democracy, technology and free enterprise does. Automobiles were invented in Europe. They were a much better automobile, further advanced; they had them years before this country. But there was no democratic climate in Europe that could have produced a Henry Ford with the absurd notion that the working man or the ordinary people should be entitled to automobiles. Neither were there any working men in Europe who thought they had a right to an automobile.

I learned this definition of democracy from a Pullman philosopher and it is good! "A Democracy is a country in which everybody thinks he is as good as everybody else and a darn sight better than most of them." Because he felt that way, Henry Ford conceived modern mass production and the working men who felt that way wanted to buy cars. Nobody had any notion that he wasn't entitled to one or that it wasn't fitting and proper to his station in life.

Now, let's take technology. This is the machine that multiplies a man's strength by a billion times. One anemic citizen pushes a button and does the work of 1,000 coolies—this is technology. It gives you the accuracy to measure things to the 1/1000 of an inch.

The result of democracy, technology and free enterprise is productivity. We have a fantastic standard of living for the simple reason that up until now the American working man has out-produced anybody else on earth. We have the highest paid coal miner in the world; also, we have the man that produces six times as much coal as anybody else. You can take it down the line in all kinds of things, but it is the productivity that created the wealth which gives us our standard of living and which permits us to afford both democracy and culture with inside plumbing.

I don't want to belabor this point, but always 1945 is the year progress exploded. To think of the world as still being 25,000 miles around like you did when you went to school is like thinking of money in terms of 1914 dollars. The mile doesn't mean what it used to mean and neither does the dollar, but of the two the mile has shrunk much more than the dollar.

Let me try to give you an example of some obsolete concepts. If I were to tell you that each new jet transatlantic aricraft would carry as many passengers as the *Queen Mary*, most of you would doubt it. This is because you are still using obsolete concepts based on three dimensions—length, width and height, which really used to be a pretty valid method, but it isn't any more.

Let me illustrate: The *Queen Mary* makes one round trip in 15 days and she delivers 1,500 people here and 1,500 in Europe. The new jet transports will make one round trip every day; every day they will deliver 100 people here and 100 in Europe. At the end of 15 days one jet and one *Queen Mary* will both deliver the same number of people.

Change is inevitable, but when you make change on purpose you make progress. Change from Nero to 1930 was an accident. From 1930 to 1945 we progressed by technological osmosis. However, in 1945 somebody discovered you could make progress on purpose; you could produce it deliberately as a product.

There was a time when war was very simple and uncivilized! A bunch of men went out in a field and batted each others brains out while the rest of the people went on living as though nothing much happened. It is not that easy now. Your whole economy gets involved in it. In a modern democracy when you have a war you do pretty much what you do in your home town when you have a

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The photos on the left of the page—Ladies' Luncheon and Fashion Show. Photos on the right of the page—casual shots of convention activities. Upper and center—Banquet scene; lower—greeting student chapter members from Northeastern University.

fire. No community has a water system rather exclusively for fighting fires. You have your domestic water supply system for washing the kids, mixing it with your scotch, doing the dishes, watering the lawn, etc. Here and there around the city you have fire hydrants, or fire plugs. When you have a fire, the fire department rushes out and hooks into that fire plug. The minutes this happens every valve in that domestic water supply system, every inch of pipe, every pump becomes a fire fighting piece of equipment. Your whole water supply becomes a fire fighting system.

Already in your lifetime there has been more technological change than in the previous history of the world. In each succeeding year there will be still more progress. Every year of your life will see more technological progress than used to take place in a generation.

That little world in which you were born and educated isn't here anymore. Now, what do we know about this new kind of progress? Well, we don't know too much, but we do know that it is near the time that somebody stopped this platitude that you can learn from history. If there is anything that we ought to learn from history, it is that mankind has never learned anything from history even when he could.

Clubs were good weapons for thousands of years. Then some joker invented the bow and arrow and this was considerably more complicated. It had three pieces, different materials, moving parts, and wear. It had a consumable missile. It required logistics; the warrior had to have another arrow with him when he shot his last arrow. The bow and arrow didn't last as long as the club.

Then you progress to the rifle and that is infinitely more complicated. Now the rifle was a good weapon for quite a number of years but it won't last as long as the bow and arrow. How long was the B-36 a good weapon? The newer and the more complex anything is, the sooner it becomes obsolete. The plane coming off a production line is obsolete compared to the one on the drafting board.

Take the idea over into your civilian lives. Most of you have a radio around the house probably 10 or 15 years old and it still plays. But what happened to that electronic marvel, that great postwar electronic invention—the 7" television? What was its life span? The newer an invention is and more complex it is, the sooner it becomes obsolete.

You don't see the picture of Uncle Sam in front of the post office anymore saying, "I want you." If we had a cartoon now, it would be something like this: it would show Uncle Sam a one armed man on a flying trapeze. He would be swinging back and forth here, and you would be looking at a trapeze over there. This would be the ordnance weapons of today, and over there would be the ordnance weapons of tomorrow. He would know that somewhere he's got to let go of one and fly through the air and grab the other. You are half way between hand grenade thinking and Buck Rogers. From muscles to missiles is a whale of a long leap.

We don't know too much about war, but let us consider a couple of things that we do know. War, hot or cold, is a competition. It is one of the most unusual competitions in the world. It is the only competition in which they give no prize for second place.

Technology is a peculiar critter: It has no morals—it doesn't care whether it is used for good or evil; it has no nationality—it doesn't care whether it is used by friend or foe; it is very efficient—it will eliminate polio or people; it has no feelings—all it cares about is if you know your mathematics.

Technology can be used to create a hell or a paradise. The challenge is can civilization supply the morality and the "know-how" necessary to harness it for the prevention of war and the expansion of the common good.

Most people still accept the "Model T" slow-moving technology of their childhood and naively believe they are well informed. In this basis you can reassure yourself that other people won't have "A" bombs until 1970, or that Sputniks, Explorers, etc., can't be put into space. To keep this happy frame of mind, all you have to do is ignore both facts and the reality of the fantastic technical progress that has been made since 1945.

Let's face up to a real fact. When we were making progress very slowly, we weren't too bright in keeping up with it. Mankind usually lags behind. Let's go back mentally to the horse and buggy days. A lot of people come down to Washington and they park in front of the musty, hallowed Smithsonian Institute.

They go in the museum and they laugh at the primitive cars inside. I suggest that we proceed more intelligently. Let's start by looking at the horseless carriage inside and then go out and look at the job we parked outside.

Inside it is true that some of the early automobiles had buggy whip holders. It is true that the lamps were basically buggy lamps fastened to the frame. You must remember that a buggy lamp in those days showed maybe 5 or 10 feet. When a fellow was driving at night in a buggy at 5 miles an hour, it was quite all right to have a lamp fastened to the buggy. It didn't project a beam anywhere.

All the driver could see in front of him when the lights were lit was the dimly illuminated rear view of the horse. When the horse turned a corner, the lights fastened rigidly to the buggy showed straight ahead until the buggy itself started turning. Then they came back on the flanks of the horse. At five miles an hour this was quaint; it probably was fun turning into the dark in a horseless carriage at 10 miles per hour.

But isn't it a little bit stupid that in 1958 when you are driving a car on an eight lane super toll highway at 60 miles an hour, you have two lights fastened rigidly to the frame of the car so that when you turn the corner you have no lights showing where you are going, but you have two lights beamed hundreds of feet straight ahead where you are not going? Thanks to engineering progress, where you used to have two lights showing in the wrong direction, we now have four lights showing in the wrong direction.

When I was a child people used to go around and say how we were unprepared when World War I happened. And later on I heard that we were unprepared when World War II happened. This is a lot of folklore and it just isn't so! We have never been unprepared! When World War I came along we were thoroughly prepared to fight the Spanish American War. And when World War II came along we could have fought World War I brilliantly.

Handicapped by Experience

We suffer from a chronic disease in our industry as all industries suffer from diseases. Ours is a tendency to fight the last one over, to be handicapped by experiences!

Democracies do not have wars as an instrument of policy. They don't plan on starting them. This is the prerogative of any potential enemy. If he decides that he doesn't want a war, there won't be one. If he decides he wants one, then there will be one. Since he can make that decision, he can also decide whether he would rather do it in the spring, or

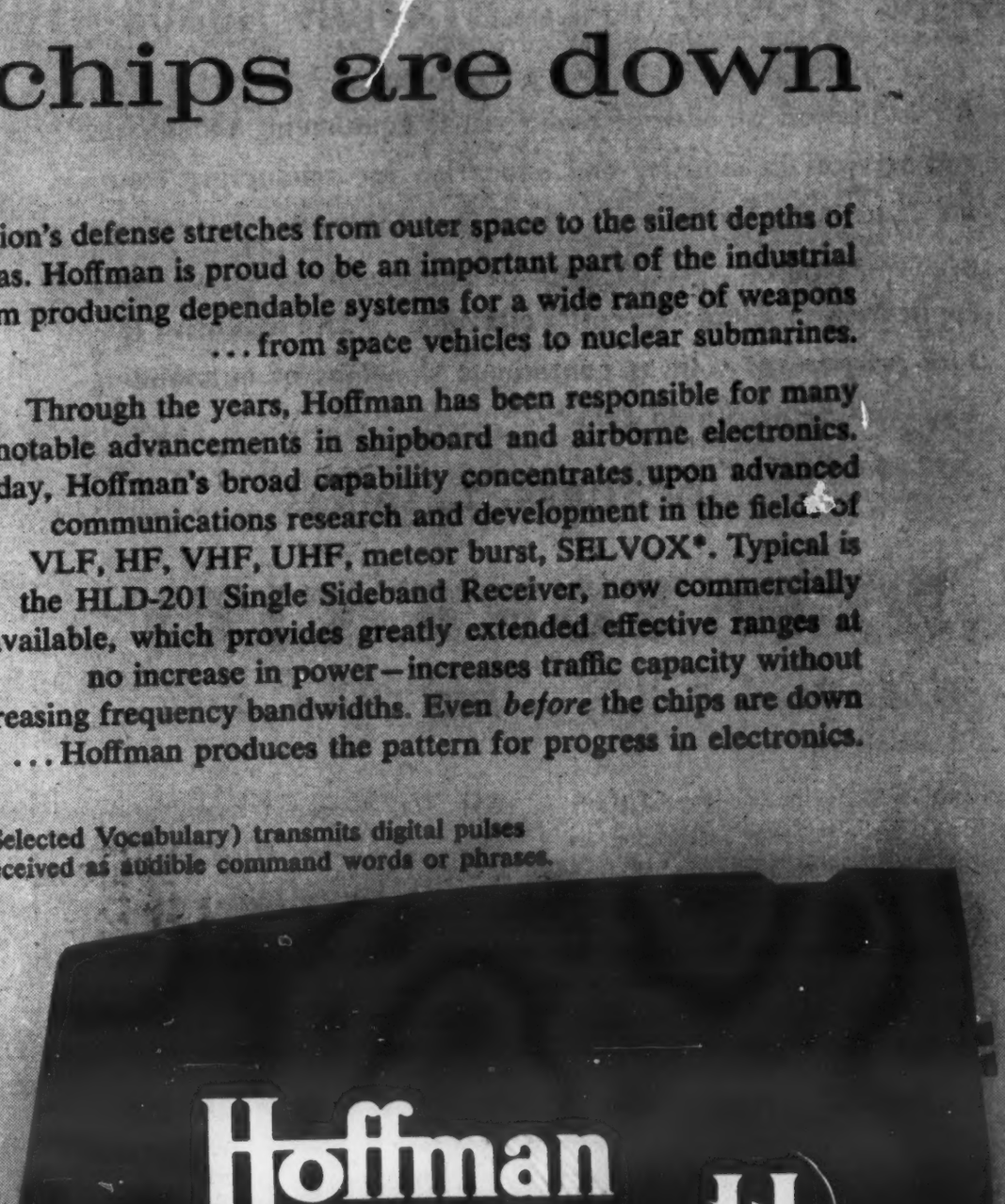
(Continued on Page 56)

when the chips are down

The Nation's defense stretches from outer space to the silent depths of the Seven Seas. Hoffman is proud to be an important part of the industrial team producing dependable systems for a wide range of weapons ... from space vehicles to nuclear submarines.

Through the years, Hoffman has been responsible for many notable advancements in shipboard and airborne electronics. Today, Hoffman's broad capability concentrates upon advanced communications research and development in the fields of VLF, HF, VHF, UHF, meteor burst, SELVOX*. Typical is the HLD-201 Single Sideband Receiver, now commercially available, which provides greatly extended effective ranges at no increase in power—increases traffic capacity without increasing frequency bandwidths. Even *before* the chips are down ... Hoffman produces the pattern for progress in electronics.

*SELVOX (Selected Vocabulary) transmits digital pulses which are received as audible command words or phrases.



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McLean (*Continued from page* 14)

the Vanguard's shell so that one will always be pointing at the sun.

Estimates of the life of the solar cells in the Vanguard vary from a few years to several hundred, due to many unknown factors of space such as meteorite bombardment, cosmic dust, intense heat and cold, and X- and Gamma-radiation. However, it is expected that, unless they are damaged, the cells will outlast the radio transmitters which they power and the satellite itself. Previous satellites, launched by both the United States and the Soviet Union have been able to transmit their radio signals to earth for only a few weeks at most because of the short life of the standard batteries used.

Future

At present, the cost of solar cells is still the limiting factor to their widespread use. Today, the cells cost about $100 for each watt they can produce. But even this figure is one-fifth of what it was only three years ago. As the cost comes down further, new uses can be envisioned.

Much study is being made toward the development of large-area solar cells. Some of the methods proposed for this involve electroplating, sintering, casting, evaporation, etc. These studies are continuing and one or more may prove to be the answer to large-scale applications. Among these applications are:

A remote weather station which could measure various meteorological data and transmit it back to civilization by solar-powered radio transmitters. A solar-powered hand transmitter could prove invaluable in air-sea rescue work both in peace and in war. Future satellites may be equipped with large solar energy converters, which could supply electricity for more powerful transmitters designed to send considerably more information back to earth. And eventually, manned space-stations may derive their power from solar cells.

In areas where electricity is not available, a house could be shingled with solar cells so as to provide enough electricity to supply all of its power needs.

In underdeveloped countries, the application of solar energy could have tremendous sociological and political impact. The possibility of a solar-powered pump, which could make fertile fields out of deserts, is enough to stagger the imagination.

All of this adds up to a brilliant new science, still in its infancy. The future of the "Sun at Work" seems limitless.

— GOVERNMENT —

DYNA-SOAR The Air Force has named Boeing Airplane Company and The Martin Company to head competitive teams for developing a man-carrying space glider. The vehicle, called the Dyna-Soar, will be designed to blast off like a rocket, orbit the earth like a satellite and then land on earth like a conventional plane. Members of the Boeing group are: Aerojet-General Corp., Chance Vought Aircraft, Inc., Missile Division of North American Aviation, Inc., Ramo-Wooldridge Corp., General Electric Co. and Autonetics of North American Aviation, Inc. Joining The Martin Company team are: Bell Aircraft Corp., American Machine & Foundry Co., Bendix Aviation Corp., Goodyear Aircraft Corp. and Minneapolis-Honeywell Regulator Co.

FIRST ACKNOWLEDGEMENT CARD ISSUED FOR PICKING UP SIGNALS VIA THE MOON Amateur radio operators, who successfully pick up the moon-bounced signals from outer space during calibration of the satellite-Minitrack stations, can receive a "QSL" card acknowledging their reception by notifying the U. S. Army Signal Research and Development Laboratory at Fort Monmouth, N. J., or the American Radio Relay League at West Hartford, Conn. Their help is valuable during the calibration period and thus the amateurs make a direct contribution to the U. S. satellite program.

ATOMIC ENERGY COMMISSION John A. McCone, former Air Force Undersecretary in the Truman Administration and Los Angeles industrialist, has become chairman of the AEC. President Eisenhower cited Mr. McCone's predecessor, Admiral Lewis L. Strauss, for "exceptionally meritorious service" in the interests of national security, and presented him a Medal of Freedom.

NUCLEAR SPACE SHIP The General Dynamics Corporation, General Atomic Division at San Diego, California, has been awarded a $1 million contract authorized by the Advanced Research Projects Agency of the Defense Department to study the feasibility of a radical new air and space ship that would be propelled by means of controlled nuclear explosions.

NRRO The Navy is planning to build a $60 million Naval Radio Research Observatory near Sugar Grove in the West Virginia mountains. The new observatory with a giant radio telescope will be one of the foremost scientific installations for outer space studies and research on the earth's atmosphere, as well as geodetic and geomagnetic data on the earth itself.

COMMERCE DEPARTMENT MONEY BILL President Eisenhower has signed a bill providing approximately $190 million for various air navigation and airways modernization facilities. The new law makes available $158.5 million for air navigation facilities; $31.5 million for the independent Airways Modernization Board and $11.5 million for the U. S. National Bureau of Standards, which includes $1,261,000 for missiles parts measurement work.

133 DEFENSE COMMITTEES ABOLISHED On July 1, 133 of the 299 joint Defense Department committees were abolished. This action by the Defense Department resulted from the Secretary of Defense's recent instructions for a review of the inter-departmental committee structure in order to accelerate the decision-making process. Any of the essential functions formerly performed by the 133 committees will be reassigned to the proper office or activity. Of the remaining 166 joint committees, 72 committees were continued without further review and 94 joint committees continued until 1 August, pending further study.

NEW AIRCRAFT The Army of the future will have a versatile aircraft that will be able to take off and land like a helicopter, operating in the air as a conventional airplane with long range and high speed. No airports or specialized take-off or landing equipment is required. By rotating propeller ducts to a vertical position, the pilot returns them to a horizontal position for forward flight, reversing the procedure for landing. The aircraft, which is being developed by the Doak Aircraft Company, is powered by a T-53 shaft turbine engine.

TO GIVE SMALL COMPANIES a better opportunity to increase their participation in government research and development work, the Small Business Administration has compiled a list of 1,100 small firms that would like to bid on government contracts. The list will be made available to the procurement offices of the Department of Defense and other government offices in all parts of the country. Periodical revision of the list is planned and small firms wishing to be listed may be reviewed for inclusion by contacting the nearest Small Business Administration field office.

"REGISTER OF PLANNED MOBILIZATION PRODUCERS" An unclassified edition of the annual "Register of Planned Mobilization Producers" is now available to the public for the first time. The Register lists about 18,000 plants with whom the Army, Navy and Air Force plan for military production in a war emergency. Each plant is cross referenced to the appropriate military representative, known as the "Armed Services Procurement Planning Officer," who coordinates military planning with that plant. The 1958 edition of the Register may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for $1.00.

DRONE PHOTO CONTRACT The Army has awarded Chicago Aerial Industries, Melrose Park, Ill., a contract to develop a strip photography system for use in drones for photographing the terrain over which they fly. The Army Electronic Proving Grounds at Ft. Huachuca, Arizona, will use this valuable tool for route surveillance and analysis in field problems. Basic components of the system will be a camera, an electronic sensor and control network, and a gyro stabilized mount.

HIDAN Of interest in air traffic control developments is a completely self-contained radar navigation system called HIDAN (High Density Air Navigation), which was recently demonstrated to industry and government officials in Washington, D. C. The system, manufactured by General Precision Equipment Corp., New York, provides a constant picture of the location of plane in relation to where it should be at all times. By predicting arrival times with extreme accuracy, flight control scheduling with HIDAN will eliminate stacking and scheduling problems at congested airports. The HIDAN system combines GPE's RADAN technique, which supplies continuous ground speed and drift angle, with a computer.

CONTRACTS: ARMY: Motorola, Inc., navigation control and guidance system for drone aircraft, accessories and auxiliary items, $2,912,274; North Electric Co., 132 manual telephone switchboards, $4,136,000 & manufacture of military electronics and communications equipment $4,631,000; Tung-Sol Electric, Inc., 3 varying items of electron tubes, $40,060; Sylvania Electronic Defense Laboratory, research and development for continuation of electronic development work in field of missile defense, $2,600,000; The Ramo-Wooldridge Corp., installation and operation of an automatic data processing system, $13,500,000. NAVY: General Electric Co., production of guided missile launch support equipment, $16,000,000; Raytheon Manufacturing Co., powerful radio communications relay sets, $15,000,000; Sperry Gyroscope Co., a division of Sperry Rand Corp., production of radar sets, special field test equipment and related spare parts for TERRIER, $19,000,000; Westinghouse Electric Corp., manufacture of electric motors to drive Mark 37 torpedo, $600,000; Machlett Labs., Inc., three varying items of electron tubes, $37,500. AIR FORCE: Lewyt Manufacturing Corp., transistorized indicators for SAGE, $2,520,201; Scientific-Atlanta, Inc., developing a high-speed antenna pattern recording system, $175,000; Burroughs Corp., construction of 24 coordinate data processing systems for SAGE, $17,418,352; Magnovox Co., components for the AN/APN-59 radar sets, $1,600,000; Bendix Aviation Corp., cockpit instruments for F-105 and F-106 aircraft, $2,400,000.

— INDUSTRY —

NEW CORPORATION: ARINC Research Corporation, a wholly-owned subsidiary of Aeronautical Radio, Inc. (ARINC), has been established in Washington, D. C. As successor to ARINC's Reliability Research Department, the new firm will provide reliability consultation services to industrial users of electronics, as well as to the military services and other government agencies. Research activities of the new organization will be directed by C. R. Knight, formerly director of ARINC's Reliability Research Department.

STOCK MARKET NEWS: Two brokerage offices simultaneously introduced closed-circuit television to transmit stock market quotations. Bache & Co. in New York is using a system installed by Hallamore Electronics division of Siegler Corporation and in Los Angeles, California, E. F. Hutton & Co. is using a system developed by the Kin-Tel division of Cohu Electronics, Inc.

(Continued on Page 37)

PANEL DISCUSSION

future of self-contained & ground control navigational aids

● Panel Moderator, Captain Paul Goldsborough, USNR, Staff Director for Communications, Office of Sec. of Defense (S&L) ● Lt. Col. Darral J. Freund, USAF, Assistant Chief, NavAids-ATC ● B. F. McLeod, System Communications Engineer, Pan American World Airways System ● LCmdr. Robert T. Norris, USCG, Chief, Electronics Section ● James Anast, Acting Technical Director, Airways Modernization Board ● Vernon Weihe, President, Institute of Navigation.

Mr. Goldsborough: The subject of our panel discussion is The Future of Self-Contained and Ground Control Navigational Aids. The panelists were given a free hand in developing the subject based on their background and experience which include a great many years of technical and operative know-how. It is a pleasure to introduce the first speaker, Lt. Col. D. J. Freund, who will address his remarks to the Doppler system.

ONE YEAR AGO, THE DEPARTMENT of Defense issued the following public statement on navigation which was of far reaching importance:

"Washington, D. C.
June 7, 1957.

The Department of Defense today released certain of its important Doppler Radar Navigation Systems, and is making them available for manufacture and use of civil aviation in the interest of flying safety and economy.

The new air navigation systems have been used selectively in military aircraft for some time, and are scheduled for wide use in various operational aircraft.

Doppler systems utilize air-borne radar, transmitting electro-magnetic impulses to the earth's surface which bounce back to an air-borne receiver, making it possible to determine the aircraft's speed and precise position over the ground. The radar measures the apparent difference due to the Doppler effect between the received and transmitted frequency."

When this announcement was made, there wasn't any extensive coverage in the press nor was there any unusual excitement in aviation circles. Yet this action, to open the door for civil use of Doppler navigation radars, could well have been a major milestone in navigation.

The de-classification of Dopplers was significant for another reason as well. It was tangible evidence of the military desire to support fully the attainment of a common system of navigation and traffic control. To further clarify this point, I would like to explain briefly how the de-classification of Doppler navigation equipment came about.

For some years, the Armed Forces had been looking for improvements in navigation equipment which would make aircraft less vulnerable during combat missions. They wanted equipment which could not be jammed; they wanted equipment which could be used without detection by the enemy, and finally, they wanted flexibility to fly anywhere in the world without dependence upon a ground environment. Doppler systems were one of a family of self-contained aids developed for these purposes. Right from the start, the Doppler navigators were successful and it wasn't long before the services realized that they had a navigation tool of great potential for all of aviation, not just the military.

Now it happened that the Doppler systems came into being about the same time that our nation was awakening to the full necessity of having a single common system of navigation and air traffic control for all aviation (civil and military). Prior to this awakening the United States had "preached" the philosophy of a common system but had not "practiced" it. The incident which finally brought us to our senses was the VOR/TACAN controversy. It was apparent, in developing the VORTAC concept, that the economic and operational penalties of separate systems for the military and for civil aviation were so high that a common system in the future was an absolute necessity.

In effect, the atmosphere became favorable for constructive action. The military services had a new navigation tool of great potential to aviation and they understood the fundamental need to make this equipment available to the common system. The only roadblock to such action was the security restrictions attached to the Doppler sets. This matter was studied carefully for several months and finally the Armed Forces saw their way clear to de-classify some of the Doppler equipment.

During this past year, since the release of Doppler information by the Department of Defense, great effort has gone into planning for Doppler systems and into developing new Doppler hardware. Yet, amidst all this effort there has been uncertainty as to what effect Dopplers will have on our older systems. Will Doppler replace other navigation aids as TV replaced the radio? Or will Dopplers find a complementing role in navigation as airplanes have in the transportation field? Perhaps this panel will help us clarify these issues.

As one contribution to a better understanding of the relationship between self-contained and ground based aids, I would like to outline for you some of the thinking and planning the Air Force has done in the three main categories of navigation—namely long distance aids, short distance aids and self-contained aids.

Let us consider the long distance aids first. The Air Force has been active in this area for many years. Some of you may recall that we did considerable work on low frequency Loran in the 1940's. We also developed the Navarho system (which has since been shelved) and we developed the Loran-C system which is now being evaluated by the Coast Guard and Navy. Despite our experience in the field, we find ourself in this position. For our combat missions we have no requirement for a ground based long distance aid. On the other hand, we recognize that for air traffic control purposes, a long distance system may be necessary. Furthermore, if a long distance aid is incorporated into the common system, we will use it. In line with this thinking, we have been a firm supporter of our national policy which advocates a single long distance aid to be used internationally by all aviation. Although we have supported this concept of a single system for all users, we do feel that any development of long distance, ground based aids is a proper responsibility of the AMB. Accordingly, the Air Force has discontinued all development work in this area.

Now a few words about short distance aids. In considering this subject there is one important fact that should be kept in the back of our minds, i. e., any basic change in a ground based navigation system takes much time and many dollars. To re-equip the Air Force fleet with a new piece of electronic hardware takes five to ten years.

With this in mind, let us turn to the Air Force problem. We are now about halfway through the transition from low frequency aids to TACAN. Most of the investment in equipment had already been made and it amounts to approximately 200 million dollars to date. Furthermore, since the low frequency aids are not capable of handling our high performance jets we are now committed to TACAN and cannot backtrack. This is a very important point, especially for those who are planning the common system of the future. There has been opinion expressed in the press that no sooner had the VORTAC decision been made than the Air Force came out with another new black box (i. e., Doppler radars) and would soon be forcing this equipment on the common system. The fact of the matter is that the primary method of navigation for the Air Force

for the next decade, or more, will be TACAN.

We can extend this same thinking on TACAN to the United States aviation as a whole. I would venture to say that the conditions which tie the Air Force to TACAN are similar to conditions which tie the airlines and the private flyers to VOR. As a consequence, we are convinced and we feel it cannot be repeated too often that the navigation system for the United States for many years to come must be VORTAC. I am sure that the AMB is fully aware of the extent to which the United States is committed to the VORTAC program.

The last category of equipment I wish to discuss is the Doppler aids. I will give a few statistics about Doppler equipment and indicate some trends that we see in the future.

I'll start with some statistics on the weights of Doppler systems. Let us consider the range of weights between low and high performance systems, starting from 1953, going on through the present time, and then projected on to 1965. In 1953 the range was 450 to 700 pounds. These were hardly systems that could be put into most aircraft. In 1958, we had a range of 175 to 250 pounds (a little more practical). And by 1965, we estimate that the weights will be reduced to a range of 100 to 150 pounds, which is a realistic figure for a good many aircraft.

I would like to emphasize that these figures are complete system weights including all components, namely, the Doppler radar, the computer and the heading reference. Thus, if an aircraft had a satisfactory heading reference device and computer already installed, the additional weight to obtain Doppler ground speed and drift would only be that of the radar sensor.

Next, a few words on the trend of weights for the components. In 1953 the weight of Doppler radars was very high (200 to 380 pounds). As time passed, these weights were reduced sharply and by 1965 we estimate that they will be down to 50 pounds or so. You can see that the same trend applies to computers. In 1953, the weights varied from 100 to 300 pounds. By 1965, we expect them to be 25 to 40 pounds.

For heading reference devices, the story is different. Between 1953 and 1965, the weight remained relatively constant. In this case, the research and development effort has been directed to improving accuracy rather than reducing weight. And there is a good reason for this. The heading reference devices are now the most inaccurate component and the main limiting factor on over-all system accuracy.

The gyro-magnetic devices have greater error than any other component. This is improved somewhat with the combination of ERDR (earth rate directional reference) and the free gyro. Even so, the heading reference errors are still expected to be greater in 1965 than the computer or Doppler radar.

The following are some calculated system accuracies that could be obtained by various combinations of components.

Calculated Position Error
of Typical Doppler Navigation Systems
(95% Probability)

	#1	#2	#3
Velocity	2%	0.8%	0.3%
Drift	1°	0.5°	0.15°
Computer	1%	0.5%	0.1%
Heading	1°	0.75°	0.25°
System	2.88%	1.67%	0.54%

I would like to give acknowledgment at this time to Mr. Walter Fried of Wright Air Development Center who prepared these statistics.

You can see from this material that the Doppler aids have tremendous potential in the navigation field. There is no doubt in our minds that the Doppler equipment will find a place in our over-all system of navigation in the future. As to the exact place, we are not one hundred percent certain but we do have some ideas. In addition, we feel that any thinking at this stage which puts the Doppler equipment in its proper perspective would be very beneficial since it could prevent much unnecessary effort in the future in wrong directions. Meetings such as this one today could play a major role in setting the proper course, and I hope that the presentations and panel discussions will help all of us in seeing more clearly the correct way to go in the future.

From a military stand point, our course is already fairly clear. We must go to self-contained aids in many of our combat aircraft for reasons which I mentioned casually earlier in my talk. While these systems do not meet yet fully our requirements for accuracy, we do see marked improvement in accuracy within the next few years.

For other than combat flying, our problems are very similar to the airlines. We need an accurate system of navigation for flying the federal airways under traffic control procedures. As I mentioned earlier, the Air Force is committed in this type of flying to the TACAN system for many years to come. Thus, for our mission flying we will rely upon self-contained aids and TACAN where it is available, and for flying the established air routes we will rely primarily on TACAN. It is apparent from this that all of our aircraft will carry TACAN and some will carry a self-contained navigational aid as well.

If and when the time comes that we can rely primarily on self-contained aids, we may then phase TACAN out of some of our aircraft. We do feel that this possibility is still a number of years away. In the meantime, our present development work is centered on the autonavigator concept from which we hope to get the optimum arrangement of ground based and self-contained aids for our aircraft. Since I understand Mr. Weihe will cover this concept during his presentation, I will not dwell on it in detail. It is enough here to say that the heart of our future navigation system will be a computer. It will accept sensing information from TACAN, from Doppler radars, from information available in the aircraft such as air speed and heading, and from any long distance or other aid which may be developed. The computer will discriminate and use the sensing information which is most accurate at any instant. The particular combination of computer, display and sensors in any aircraft will depend upon the aircraft's mission and how much equipment the aircraft can carry.

This then is the program of navigation which the Air Force sees for the future. In summary, here is our plan. In long distance aids, we have discontinued development work and will rely upon the AMB to find what equipment, if any, should go into the common system. In short distance aids, we are committed to TACAN for many years. With respect to Doppler systems, we will use them extensively as a primary means of navigation for combat flying and as a supplement to other navigation forms in airways flying.

Today we are in the strange position of having a great many choices of equipment for navigation. Yet the common system planners have a very difficult problem since so many users are committed to so many different forms of navigation. This problem is acute within the United States but even more so within ICAO where we must consider the wide variety of aids being used and planned by different countries. This task of combining into a single workable system the multitude of existing navigational aids to which different aviation users are committed is a momentous undertaking. Within the United States, much of the burden for solving this problem falls on the shoulders of AMB and I think that one thing all of us must do is give AMB full support in this program.

Despite these immediate problems I believe that we have, at this time, an opportunity to provide a real solution for our problems of the more distant future. By sound and courageous planning and by cooperative efforts, between agencies within the United States and between member countries of ICAO, we could make the future common system a far better and simplier one than it is today. The next speaker will be Mr. B. F. McLeod.

FEW SCHEDULED AIRLINE FLIGHTS HAVE been made without the assistance of both self-contained and ground based navigational aids. As aviation has grown up the expansion of navigation aids has generally kept pace; however ground based devices have in the past maintained the lead for civil aviation usage. For example, a modern long range air-

SCALE MODEL of 85′ diameter tracking antenna, now under construction. Reflector face surface is fabricated from Aluminum. Pedestal, Polar Cage, Declination Cage and back-up structure are of galvanized steel. Scale: ¼″ = 1′.

New Blaw-Knox 85′ Diameter Tracking Antenna

This newest Blaw-Knox 85′ Diameter Tracking Antenna will be part of a telemetering operation connected with missile and satellite development.

Its design is fully determinate. All structural members of the assembly are analyzed for stress and deflection before fabrication. Coupled with shop fabrication and field erection to rigidly accurate tolerances, it is capable of the highest gain, with a minimum of distortions or aberrations.

The entire drive system embodies such critical design requirements as infinitely variable movement with negligible creep or overrun for tracking. The slewing drives are capable of the extremely rapid acceleration and deceleration necessary to focus on supersonic targets.

Pioneering like this is the latest step in a long series of Blaw-Knox developments. Such milestones as the Guyed Vertical Radiator design in AM radio, the first radar antenna used to bounce signals off the moon, and the Tropospheric Scatter Antenna for over-the-horizon television have marked Blaw-Knox as a world leader in advanced design, fabrication and erection techniques.

Blaw-Knox welcomes the opportunity to translate your most advanced concepts into highly reliable operating equipment. Contact the Antenna Group.

Antennas—Rotating, Radio Telescopes, Radar, Tropospheric and Ionospheric Scatter.

BLAW-KNOX

BLAW-KNOX COMPANY
Blaw-Knox Equipment Division
Pittsburgh 38, Pennsylvania

plane is equipped with the following systems relying upon ground based aids: ADF, VOR, ILS, Loran, Marker and ATC transponder. Self-contained aids are the compass, high range radio altimeter, sextant and weather radar. Recent government sponsored development of self-contained devices is beginning to make new techniques and hardware available to civil aviation and in the future increased emphasis on self-contained systems is to be expected. As my airline's most urgent need is for a better long range navigation system I would like to concentrate on this requirement.

Since the ICAO COT Division meeting in 1946, the international airlines have been actively looking for a better long range navigation system. Several radio aids have been proposed as being promising developments for an international standard, but until this time none of them has ever matured to this status. These include such well known names as low frequency omni range, Loran, Consol, Navarho, Radio Web and many others.

During the last three years, new self-contained devices have aroused considerable interest among the airlines, as these devices can overcome many costly and time consuming implementation and modernization problems. This type of equipment is fully under the control of the user and, if properly designed, can be used in all parts of the world. A good idea of the time required to install a new ground based aid can be obtained by reviewing the implementation rate of ILS and VOR. Both of these aids were adopted as standard at the 1946 ICAO Conference. We now have VOR's on about one half of the international routes on which they are needed and ILS has a slightly better score.

For long range navigation it would be most attractive if a self-contained system could provide the desired reliability and accuracy for navigating from beyond the coverage of the terminal aid at the location of departure, to within coverage of the terminal aid at the location of landing. This immediately raises the question: What are the accuracy requirements? Actually the requirements vary depending on route environment. For example, a system providing position within 1-1/2% of the distance traveled would be acceptable for low traffic density routes, such as from Caracas to Rio. If a self-contained system of this accuracy was employed for the en-route navigation, it would place the aircraft within easy coverage of the terminal aid when approaching the destination.

Many committees have discussed the accuracy requirements for high density long range routes and a good compromise figure seems to be ±5 miles on a 95% probability basis. This stringent requirement stems from the need for efficient and safe use of congested air space rather than the ability to fly an optimum path. As the more prominent self-contained aids involve dead-reckoning computers, let's translate the ± 5 mile fix accuracy to a percentage of the distance traveled. To meet this when dead-reckoning a distance of 2500 miles, the accuracy would have to be ± 0.2%. This presents a very difficult design problem and it is reasonable to believe that any present day equipment approaching this would be very heavy, have a high initial cost and be difficult to maintain. We remain optimistic that with the large amount of research in the self-contained field it may some day be practicable.

If periodic fixing is available, the accuracy requirements of the dead-reckoning device can be reduced in relation to the accuracy and frequency of obtaining fixes. For example, in the North Atlantic, where (because of air traffic control requirements) the long range navigation accuracy needs are the greatest, a self-contained dead-reckoning system of 1-1/2% accuracy would provide location to better than ± 20 miles at the mid-point. If this position could be corrected with a fix accurate to within ± 5 miles, the position would be accurate to about ± 20 miles or better when the aircraft comes within range of terminal aids. More frequent updating with accurate fix information would, of course, provide improved accuracy.

We believe that a relatively simple self-contained system consisting of a sixty-pound Doppler radar set, a twenty-pound compass system and a fifteen to twenty pound dead-reckoning computer can provide a reliable system accuracy of 1-1/2% or better.

In order to determine what long range aids are best for PAA's requirements, we are engaged in a wide scale evaluation program. A DC-7C in our Atlantic Division service has been equipped with the following self-contained aids: a GPL RADAN set (which was made available through the cooperation of the Air Force), a very simple PAA do-it-yourself computer, a Sperry Gyroscope C-11 compass with a low drift gyro and a Kollsman precision periscopic sextant. Flight tests have just been completed with a Mark 7 Decca/Dectra set installed on an Atlantic Division B-377 airplane. Edo cockpit-operated Loran sets have been tested on two other B-377 aircraft. A Latin American Division DC-7B airplane just recently was equipped with a Canadian Marconi Company Doppler radar set and a dead-reckoning computer from the Computing Devices of Canada Company. We expect by late summer to equip a Pacific Alaska Division airplane with a Ryan Doppler radar set and longitude/latitude dead-reckoning computer. Also, we are discussing with the Decca Company the possibility of evaluating their DIAN system late this summer. During late fall or early winter, we expect to test a Doppler set on one of our B-707 jets. This should round out our program and show what performance can be expected from numerous equipments under nearly all service conditions.

Our investigation of self-contained aids has not excluded inertial devices; however, it has not yet become practicable for us to test any of this hardware. We are remaining in close contact with several manufacturers and are keeping them advised of our requirements for navigation.

The testing to date has produced much valuable information. In most cases, the manufacturers have been provided with information which is resulting in substantial improvement of their products. In our early testing of Doppler, drop-out occurred at greater than an acceptable rate and the manufacturers have made progress in overcoming this limitation.

The drift rate of the new gyro has been greater than anticipated, but our feedback of information has resulted in improvements and now the average drift is usually less than one degree per hour. Our first calibration of the C-11 magnetic compass system left further improvements to be desired, but the stability has been good. Until further improvements are made in the free directional gyro mode of operation, we plan to use this mode only when flying through regions where magnetic signals are not reliable. Actually, magnetic and free direction gyro compasses are expected to contribute the largest error of any element of a Doppler radar navigation system.

So far we have not been able to concentrate on the evaluation of dead-reckoning computers because of the need for first developing accurate and reliable input information. This stage has now been reached and we will take a good look at computers reading out in rectangular and polar coordinates. When using rectangular coordinates, the planned track will serve as the reference. When using polar coordinates, the North Pole will be the reference and the display will be in terms of longitude and latitude. We are of the opinion that a relatively simple dead-reckoning computer will have to suffice during any early usage of Doppler. A building block type of system is preferred so that additional features can be added as they can be justified. As a minimum, the computer should permit selection of desired track in terms of magnetic or grid heading, provide for manual and automatic flight and display miles traveled along track and miles deviated to the side of track. At a later date, we will consider adding present position, most likely using coordinates of longitude and latitude. At a mid-May meeting in Washington, D. C., the AEEC Doppler Radar Subcommittee made good progress in developing a characteristic for an airline dead-reckoning computer.

Our tests on the Dectra system produced good results. The only ground facilities available have been two track forming stations located near Gander, Newfoundland, and a ranging station near Prestwick, Scotland. These facilities provide coverage over the greater

portion of the North Atlantic, with satisfactory reception as far north as Iceland and as far south as the Azores. The manufacturer claims an accuracy of ± 5 miles in the general vicinity of the base line and ± 10 miles when well off the base line. Our tests over a three-month period have substantiated the manufacturer's claims. For checking the accuracy of Dectra, we used visual, celestial and radio fixes.

Our test of remotely controlled Loran equipment produced satisfactory results and one such set will be installed on each of our jets.

By late 1958, we feel that our investigation program will have produced enough information for us to make a sound decision for a long range navigation system well suited to PAA's world-wide navigation problem. The outlook is very promising that Doppler radar will be an important element.

For short range navigation, VOR is doing a satisfactory job and the international airlines are anxious to see more stations installed. Continuous distance measuring will considerably improve short range navigation and we are investigating ways of providing this service. DMET will be tested as soon as air-borne equipment and ground facilities become available. There is considerable question about a Doppler navigation system being able to provide satisfactory distance information in a complex terminal area traffic situation as the time required to manipulate and interpret the dead-reckoning computer may be excessive.

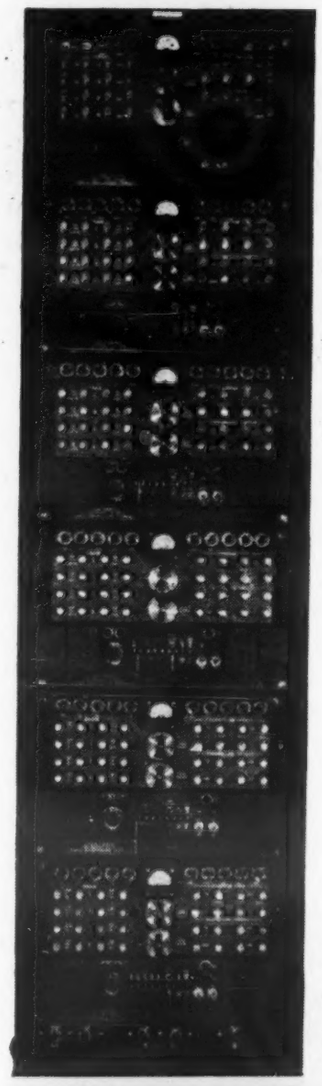
For instrument approach and landing, we feel that there is a need for an improved system which provides reliable guidance to a lower altitude. PAA recently equipped a DC-7C with a corner reflector and made some test instrument approaches at Buffalo, New York, on the Bell instrument landing system. Although this one test did not demonstrate that the system provided for completely automatic landings, it was concluded that it provided guidance to lower than the present-day glide slope.

In summary, I can say that the airlines have a need for new and improved self-contained and ground based navigational aids. It is my opinion that self-contained devices will occupy a more prominent position in future planning.

The next speaker will be LCmdr. Robert T. Norris, USCG.

I WOULD LIKE TO THANK THE association for the opportunity of appearing on a program sponsored by such an important and nationally known organization. You are very well acquainted with most techniques having to do with electronic matters. The use of electronics as a navigation tool is a well established procedure dating back to the early 1920s. I'm always reminded whenever I speak of navigation of one of the first things that I was told about navigation at the Coast Guard Academy. I was advised that as a ship's navigator, I could navigate in one of two ways. The commanding officer could either tell me where he wanted to go, and I as the ship's navigator would get him there, or the commanding officer would tell me how to go and I could tell him where he was. I have served with both types of commanding officers, but regardless of the type of commanding officer, in order to have the command navigated properly, the navigator must have an efficient all-weather tool to use if he is to know where he is at all times and how to get to the destination. Such a tool, if it is to meet national requirements, must provide information at long ranges. For long-range navigation on the surface of the earth, we perhaps have the longest range system (in the terms that people generally think of a long-range system—that is, a system providing useful information at long ranges) in celestial navigation. In comparing long-range electronic navigation devices with celestial navigation as a long-range tool, we see that electronic aids are strictly in the short-range class. Obviously, then, thinking of whether a system is a short-range or long-range aid is strictly one of definition. One facet of thinking in this field is the point one of my CAA friends often makes when he says that if an airplane flies from New York to Los Angeles, he uses a short-range navigation system, known as VOR, on a long-range flight, and this provides information in a long-range sense; therefore, it is his concept that you could consider VOR a long-range aid. Of course, we all realize, or at least most of us do, that when we speak of a long-range navaid system we are talking about a system which provides navigational information at long ranges, not one that is capable solely of providing information for long-range navigation. Self-contained aids would certainly not qualify in any sense of the word as being long-range systems but they are definitely usable on long-range flights. I should have added "when and if suitably corrected," for self-contained aids degrade in accuracy with time, speed or distance and they must be reset from time to time as the necessity arises. And that is the major reason why a ground-based system will still be necessary when self-contained systems are widely implemented. Having established quickly the continued need for ground-based navaid systems, our next major problem is compatibility. This directly involves the major users—air and surface.

One of the most fruitful areas in assisting general navigation, air and surface, is in the fields of presentation and receivers. Another aspect of this particular matter is that these areas provide an excellent opportunity to reveal system incompatibilities and to suggest ways to correct these incompatibilities. Few people will quarrel with the desirability of the concept of a single system (note I use the word system here and not aid) for long-range navigation capable of meeting all the users' re-



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These systems provide a voice-channel flat within 1 db from 300 to 3500 cycles, for each 4 kc of bandwidth occupied. Each channel is equipped with hybrid, signalling, and dialling circuits for all the standard 2-wire and 4-wire loop options.

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quirements. This is a goal stated in the current U. S. national policy. So far, what is acceptable to one group is not acceptable to the other. For that reason, some people feel that the single-system development can never be fruitful. However, as mentioned, state of art improvements in the past ten years would dictate another conclusion. It is certainly sensible that the surface and the air user in areas such as the North Atlantic or other heavily traveled areas must live and are capable of living in harmony, both from an economic and from a frequency conservation standpoint. The question of being able to meet everyone's requirements is a difficult problem. It is obvious that there is going to be a group that will never be satisfied even if you were able to tell them exactly where they were at all times with a device which was weightless, cost nothing and occupied no space. Since both the surface and the air user have the same problem—to be able to determine a position accurately and also to be able to use that position practically—it certainly seems foolish for the air user to ignore the surface user's progress and it is just as ridiculous for the surface or the subsurface user to ignore the air user's progress. The Armed Forces, naturally, realize the necessity for teamwork (although some people feel they don't) and they will, I'm sure, not tolerate such ignorance in its real sense.

The question appears to be: Is there incompatibility between the surface and air user or is it actually one of presentation and equipment weight conflict? It is true that the aircraft user has a choice of three coordinates to worry about, whereas the surface user, generally, with the exception of the subsurface user, is limited to a two coordinate problem. The air user also does not have the ability to be able to anchor. Air navigation presentation is generally thought of as a rho-theta, that is, distance and direction to go. Of course, position of some form must be known to derive that information. It is true the surface navigator's problem is different. He can stop and anchor. Time is costly but not fatal. His slower speed gives him a little bit more time finding where he is. Weight is a consideration, but usually not a major one. Certainly, ship and aircraft presentation requirements can be made mutually convertible by use of a computer; thus, compatibility begins with a black box. Such a box presents no great design problem today. Speed is another consideration. Ground-based electronic long-range aids to navigation systems must integrate over a period of time to obtain the positional data if they are to achieve long-range reception and obtain state of art accuracy under unfavorable signal to noise ratios normally encountered at the lower frequencies and at long ranges. Fifteen seconds is a long time for a 1200 kt aircraft or even a 600 kt one. So, if we are going to keep our position current, a device must apply course and speed to the output—at least in the case of the fast aircraft. Such a device is called a deadtime computer or dead reckoning assist. At first glance it would appear that the speed of a ship can be neglected, but this is not necessarily true because in certain positions you should know your position within 50 feet or better. Normally, this is not accomplished with a long-range aid but by other means; however, state of the art electronic navigation systems can provide this accuracy and a 10-knot ship travels 250 feet in 15 seconds. Here, again, to have up-to-date position information you must apply course and speed with a deadtime computer. The need for a deadtime computer is common to both air and surface navigation. Another feature, of course, that the deadtime computer or dead reckoning assist gives is the ability to ride through breaks in transmissions or even failure for some length of time. Thus, you have certain features of any system which are common to each major user.

As I stated, the job is to provide a system from which each user can extract the information to meet his requirements. Insofar as requirements are concerned, the Radio Committee for Technical Marine Services recently concluded a study which developed marine requirements for a standard system of long-distance electronic aids to navigation for marine use. Likewise, the Air Coordinating Committee approved, in May 1957, aviation operational requirements for a long-distance aid to navigation system. The requirements between the two users are not too far apart. Actually, aviation's requirement of three-nautical-mile accuracy compares very favorably with the consensus of what is or may be required within the next several years as a surface marine aid. The majority of those on the RTCM Committee concluded, for instance, that within the period 1960-1975 they would like to have an accuracy in the neighborhood of one-half mile for those regions of the world where they may operate and further that such devices provide for automatic tracking which can lead very easily to continuous visual indications of position—a specific requirement of aviation. Again, these requirements are not widely separated. I am specifically aware that the aviation requirements were developed, not on the basis of knowledge of the capabilities of any particular system, but on the actual needs of aviation within the time period beyond 1960. The group involved in writing these requirements looked ahead to see what would be necessary in the future years—not what was required last year or today but to forecast needs and requirements. The same consideration was taken by the RTCM group.

Now, we must come to the *problem*. What is on the horizon today that can fulfill the requirements? The self-contained aid will not do the job unaided. It must have an assist. The geometrical concepts relative to ground-based electronic systems have reduced themselves to the rho-theta and hyperbolic type. The rho-theta adherents immediately suggest that if we choose their method of originating our positional information we would do away with our need for computers. Unfortunately, all craft do not go to the same place and we cannot place their navigational aids at each desired destination (although it may appear we are doing so with some of the present programs). Hence, computer or manual plot would be required in any event. In addition, there is a large accumulation of information to support the belief that possible rho-theta systems at *long ranges* will never provide the accuracy necessary to meet requirements. On the other hand, hyperbolic systems definitely can be designed to a high degree of accuracy.

It thus appears we will be forced by accuracy requirements to select a compatible system of the hyperbolic variety. The United States has proposed several long-distance systems. Immediately after World War II, we thought that a hyperbolic system known as low frequency LORAN would be the answer. When this system failed to live up to expectations due to problems of separating visually the ground and sky wave another system called NAVARHO was proposed. This system was a rho-theta system and suffered from rho-theta problems at long ranges, since operational accuracies better than one degree are very difficult to achieve. During the same period that NAVARHO was receiving international publicity, another system was being developed within the Air Force for an entirely different purpose. This system was known as the CYTAC. It was a tactical bombing system which employed techniques far beyond what is normally considered necessary for a "navigation system." Although the whole system was not adopted, the navigation portion offered so much promise that additional development was undertaken resulting in the system named LORAN-C since it was an extension of basic Loran principles into the 90 to 110 kc band. Thus, it joined the medium-range medium-accuracy LORAN-A and the high-accuracy LORAN-B in the Loran family. It employs pulse techniques and utilizes cycle matching within the pulse envelope to eliminate the contamination of the ground wave by the sky wave to obtain extreme accuracy and to eliminate ambiguities. Since the Air Force established LORAN-C parameters at ranges of less than 1000 miles, the Coast Guard only had to determine its usefulness at greater ranges. As a result, the Coast Guard is presently verifying the extent of the ground wave, the extent of the first hop sky wave mode, the stability of ground wave signals at known locations, the stability of the sky wave mode at ranges in excess of the ground wave mode and the usefulness of the system on the second and third hop sky wave modes at distances in excess of 2500 nautical miles, using LORAN-

C Chain, which is operational on the U.S. east coast. Basically, LORAN-C has married the best features of standard LORAN and standard DECCA. Thus, pulse transmissions with phase (cycle) comparisons give us a highly accurate system based on hyperbolic type coordinates without significant operational ambiguities. Again, I wish to emphasize that the LORAN-C system is a hyperbolic, medium base line, pulse type system which eliminates the sky wave contamination and uses cycle matching techniques to provide high accuracy. The big advantage that LORAN-C has over CW phase comparison systems is that it gives high accuracy to the maximum range of the ground waves. Beyond the ground wave, the daytime sky wave mode can be utilized with good to excellent navigational results to a greater distance.

The United States stated at ICAO that the timing accuracy of the LORAN-C system would be in the neighborhood of approximately one quarter of a microsecond. This accuracy will not only be met but it appears very likely that it will be bettered.

I have only briefly touched on the navigational capabilities of Loran system (A, B and C) and its usefulness to all users. I believe that the system characteristics can meet the requirements stated by the maritime operator, surface and air. I believe that as long as you have a requirement to know where you are, ground-based systems must be available. Not only does the Loran system permit the properly equipped user such as the ocean going airliner and the over-ocean aircraft to find his way, to know where he is and to plan and operate efficiently, but it will serve the front line soldier and his mechanical mule to know where he is and enable him to know that the aircraft flying above his head knows where he is. The Loran system has the inherent accuracy and coverage to meet my requirements, his requirements and your requirements. I believe that the needs of maritime surface, air and subsurface navigation, both for commercial and military use, will require the continued operation of a precision shore-based long-range electronic navigation system. I believe that the general concept of Loran offers the best solution for electronic navigation at all ranges and further provides for an all-range compatible system.

The next speaker will be Mr. James Anast.

THE CURTIS SYSTEM ENGINEERING Team set forth several fundamental requirements for air navigation: (1) A navigation reference throughout air space from the ground to the highest altitude. (2) Accuracy enroute sufficient to permit lateral separation for the highest demands in particular geographical areas. (3) The air-borne equipment required to utilize the navigation reference should be kept to a minimum of cost, weight complexity. (4) The equipment should utilize techniques that are inherently reliable and which fail safely. (5) It should be a design goal to provide a navigation reference throughout the system so that one simple receiver will serve for enroute as well as terminal and ground navigation.

These are general requirements and serve only as a guide to the development of future navigation systems.

I can think of several navigation systems which almost meet these requirements. You will no doubt concede the point of all altitude coverage, even with a line of sight system, if enough ground stations are provided. Of course, the complexity of equipment and operation increases as the number of stations, and therefore different frequencies are used.

Air navigation could also be accomplished generally, as was done by the night fighters of World War II, where they were detected by radar and told either where they were or where to go. A general expansion of this technique to handle all operators would be complicated in communications, and the reliability of such a scheme, if it were entirely dependent on radar, would be questionable from two standpoints: (1) Atmospheric interference with radar. (2) Multiple failure when one ground station goes out.

Non-line of sight systems appear to meet the requirements, but there seems to be unresolved problems there, too. For example, can one have an inexpensive simplified Decca or Cytac to permit the private operator to take advantage of the over-all navigation system?

Since the system which will be used for navigation during war as well as peace, is not a non-line of sight system as vulnerable to jamming as the systems currently used for omnidirectional guidance?

I will not belabor the point further. The perfect air navigation scheme has been sought for many years throughout the world and it appears that any single technique pressed to cover the general requirements leaves some things to be desired.

Of course, there can be no perfect system. Any equipment will fail given enough time and there are economic constraints with which to cope. The goal is to meet the requirements with a reliability higher than the general system performance—for example, air frame or critical power loss.

There are two important things which can be done to increase performance. One is *duality*. This is now quite common—for example: (1) The standby VOR transmitter, (2) Dual computers for data processing, and (3) Dual air-borne VORS in air carrier aircraft.

In nature, some highly reliable organisms, the latest of which is the Homo sapiens, contain some classic examples of duality—two ears, two eyes, two lungs, etc.

The other technique is *combination*. An example might be the use by the transatlantic navigator of LORAN and celestial navigation.

Duality and combination are the stepping stones to a more sophisticated technique which has been under exploration for some time by the military and most recently by the Airways Modernization Board.

The idea is to combine devices which complement each other. The goal is to find the combinations of equipment which give some service even if most of them fail.

Let me illustrate. If in my aircraft I had only a radio compass with which to navigate, a severe thunderstorm would leave me relatively helpless—even if I had two compasses on board. But if I had recourse to a device which was immune to thunderstorms, then my chances would be excellent for satisfactory navigation.

One might say here, "Well, you now have two full sets of equipment." Let me then take one more step. Assuming that a radio compass gives a little bit of help in a thunderstorm, then the thunderstorm immune device need not be so sophisticated.

There are several excellent examples of the combined use of complementary capabilities. The classic equipment example is the combination of the magnetic and the gyro compasses.

Each has advantages that the other does not—and each has disadvantages that the other does not. They have been combined years ago into the flux gate. Now just how do they fit? The magnetic needle won't stand still, but the gyro compass is as steady as a rock. The *average* heading of the magnetic needle is *very* accurate, whereas the gyro compass heading drifts in time.

The pilot then flies by the gyro compass and every once in a while, when the magnetic compass is steady, he resets his gyro. The modern automatic pilot gets the combined data automatically by using the gyro reference. The magnetic heading error signal is inserted through a low-pass filter as an integral control.

Just once more I would like to make a biological analogy. The human, so the French say, brings into play several senses in eating—taste, sight and smell. He will still enjoy it if one or more of these senses is impaired—but not as much. These senses complement each other; each contributes something to the enjoyment of the meal. Yet a blind man eats and I recall that I survived by eating when sea sick and my taste was pretty well gone.

What elements can we combine for a highly reliable air navigation system? They are, I believe: radio navigation, dead reckoning, inertial navigation, radar (on the air-borne side and on the ground) and radar (passive position finding devices such as D/F equipment).

In each category there are many different techniques available today. There are two great problems which must be solved, and these are the problems which AMB is tackling in order to establish a logical basis for the selection of our future air navigation systems.

First, research must be done to "fit" characteristics of various techniques so as to provide several degrees of capability. The military bomber for example may need full all weather capability with radio silence. Some private pilots may well require only the navigation accuracy needed on present airways below 15,000 feet and no bad weather capability. In between these would be several different sets of requirements.

In each case, the navigation capability should deteriorate only fractionally with failure of the various elements.

Second, the government must select and furnish the ground environment to match each capability in the air. Hopefully, one ground network will suffice.

There are obviously many types of air-borne instrumentation which will be used in the future. One set which appears to be basic and is being explored vigorously by the AMB is the dead reckoner, combined with the radio navigation set in the aircraft, and on the ground the radio transmitters and the ground radar network.

I believe that we will see the equivalent to the flux valve in air navigation soon (where the ability of the aircraft to navigate for some definable distance within definable limits will be used as an aid in organizing safe separation). Correction of the basic dead reckoning will come via a "noisey" radio navigation system, augmented in some classes of aircraft by inertial and/or doppler devices—all corrected occasionally by data from a ground radar network.

The next speaker will be Mr. Vernon Weihe.

SINCE JUNE 1957 WHEN DOPPLER navigation systems were declassified, there has been a great deal of discussion at policy levels, both domestically and internationally. Many people charged with implementing or sustaining ground-based navigational systems have been confronted with the question of whether or not the advent of self-contained aids renders the ground-based systems unnecessary or obsolete, or whether it changes the type of service required from such aids.

It is not an easy matter to define the various relationships which exist between ground-based and self-contained aids without in some measure understanding the operational requirements and the relative importance of various facets of the systems in their operating environments. Many of us, without realizing it, are forever searching for the panacea which solves all outstanding navigational needs. Some of us when confronted with the facts of life attempt through classification to accept the fact that a single system will not meet all requirements and, therefore, try to reduce the number to the minimum practicable. Classification of navigational systems is an interesting mental exercise and, in general, has the greatest meaning to the person preparing the analysis. Each classification term would need to be very very carefully defined in order for classifications to have full meaning to all users. Now, as I have indicated that classifications have grave shortcomings, I will attempt to provide an approach to the current subject through the use of a broad brush classification system.

I would classify one group of systems waypoint or airport finders. These systems provide navigational information which increases with accuracy as a point of radiation is approached. Examples are the LF/MF Four-Course Radio Range, VOR, TACAN, NAVAGLOBE, etc. This class of system is very useful in that it permits a channeling of flights to a degree, and the assurance that these specified—or identified—geographic points will be reached. This class of system defines great circles which pass through the sources of radiation. To achieve high accuracy in line of position determination at any considerable distance from the radiation source, high precision of measurement at the receiving point is required. Most systems to date have been completely adequate for straight navigational purposes, but have failed to serve the requirements from the standpoint of traffic separation.

The second category of system is the area coverage type, where radiations take place from a multiplicity of ground points. These systems have a more complex accuracy contour and, in general, provide position fixing rather than track guidance. When one attempts to utilize two or more transmissions from ground points, the line of position information is seriously limited. When he goes to a lower frequency to overcome these deficiencies, a number of new troubles develops. Atmospheric and precipitation noise, propagation anomolies, skywave, multipath and ionosphere tilt become important. The user can determine his position with some degree of accuracy, but, in general, must use the previous history of the flight or other instruments to determine the direction of flight. Distance to go to a waypoint or destination is inherent in the fix information, but is normally not available to the user in simple form. This class of system exists in two forms, one of which uses the continuous wave transmission, narrow-band technique, while the other uses pulse techniques having wider signals and bandwidths. The narrow-band system is more efficient in every way than the pulse system, except that it does not have the ability to resolve direct from multipath signals. The pulse technique for any given power has considerably shorter useful range but does have the ability to utilize the more direct wave. With sophisticated instrumentation at the receiving point, it is feasible to utilize auto-correlation, or cross correlation to recover some of the lost signal-to-noise efficiency. In general, these techniques raise the level of complexity of the receiving equipment and make the service available to a smaller category of users.

The third category of aid is that which is wholly contained within the aircraft and does not utilize ground stations. During the war years, there were a number of aids in this category, such as air position indicator and ground position indicator, which made use of magnetic heading, air speed and estimated wind. Since the war, there have been two significant developments which have improved the ability to sense ground speed and drift angle in the aircraft. These are the Doppler radar sensor and the inertial sensor. These developments have created renewed emphasis on the establishment of more accurate heading reference systems in the aircraft. During the period when dependence was placed completely on track guidance or fixing services from continuously available ground-based aids, basic accuracy of the heading reference was not quite so significant. The advent of the Doppler sensor placed sufficient technical emphasis on magnetic heading reference systems that a whole order of accuracy improvement has taken place. Following this, inertial navigation developments have produced similar improvement in gyro heading reference systems.

Today, it is possible to fly for long distances with comparatively small navigational errors, using either Doppler or inertial self-contained navigation. To date, these systems have been developed primarily for automatic or manual use by specialized navigators or special navigational environment. Since the declassification of Doppler a year ago, the development emphasis has been in the direction of moving the system from the specialized navigation location in the aircraft, and modifying it so that it is directly available for pilot use in a routine fashion. Concurrently with these developments has been the necessity for reducing the amount of work required by the user to obtain the service provided. Economic factors also have become far more important, and much greater emphasis is placed on the matter of reducing size, cost and complexity, and increasing reliability. These latter factors have tended to justify some decrease in the over-all system accuracy. As these pressures create some decrease in accuracy from those of the specialized type, there is a greater need for intermittent fixing by ground-based aids; however, the requirement changes from one where the continuity and reliability of service was of paramount importance to one where pre-planned intermittent high-accuracy fixing is considerably more important. This causes aviation to be faced with a rather special situation. Those aircraft not carrying the new Doppler or inertial aids will desire continuous fixing service at some accuracy over all of the routes flown and with a minimum of interruption to service. Those aircraft carrying self-contained aids will probably be satisfied with high accuracy, limited coverage, ground-based systems, and utilize the self-contained aids to provide continuous interference-free navigational service.

GNALGRAM (Continued from page 28)

FLORIDA ELECTRONIC FIRM Among the growing electronic firms established in St. Petersburg, Florida, is Electronic Communication, Inc., which was formerly located in Teterboro, N. J., and known as Air Associates, Inc. The company maintains regional offices, a wholesale aircraft supplies division, a research division and a facsimile division in other states. Present expansion plans call for the construction of a modern electronic factory over 300,000 square feet, adjacent to their present location at 72nd Street, North in St. Petersburg. The majority of their products are manufactured for military use.

ONE OF THE TOP TEN General Telephone Corporation recently was selected by "Factory Management and Maintenance" magazine, from nearly 1000 nation-wide entries, as one of America's ten top plants of 1958. At the magazine's Awards Banquet, the publication presented General Telephone officials an original Kent Day Coes water color of Automatic Electric Company's new plant, subsidiary of the corporation.

BRITAIN AGREES TO CABLE LANDING An agreement between the British Government and Western Union authorizes the telegraph company to continue the landing of nine cables, seven of them transatlantic, at points on the shores of Cornwall and Sussex, England. Walter P. Marshall, president of Western Union, announced the 25-year landing license agreement.

ELECTRONIC TUBE WITH A MEMORY Over 100,000 pieces of information may be stored in a tube which has been developed by the Westinghouse Electric Corporation's electronic tube division for use in radars. In a fraction of a second, information received by radar can be committed to the memory of this storage tube (WL-7228) for long periods. When needed, the information can be displayed visibly on a fluorescent screen long enough for the observer to grasp.

TWO COMPANIES CONSOLIDATE The Thompson Ramo Wooldridge Corp. is the result of the recently announced merger of Thompson Products, Inc., and its affiliate, Ramo-Wooldridge Corp. Prior to the agreement, Thompson Products owned approximately 57½% of the common stock of Ramo-Wooldridge. Payment for the minority interest in Ramo-Wooldridge will be by 260,375 shares of common stock of the reorganized company. The new company will have a total employment of about 20,000 and combined assets will be in the range of $200,000,000.

ELECTRONIC WRITING UNIT IT&T has agreed to sell and lease an electronic handwriting instrument for sending messages developed by Autron, Inc., Los Angles, California. Through electric transmission, the device, called the Stenotron, reproduces handwritten messages using an ordinary pen and paper and can make carbons. At present, the device is being operated through two-wire connections in office buildings which extends to a range of 22 miles and is being field tested in the Los Angeles area. The Stenotron sells for $2,400 or rents for $40 per month.

IT'S EASY TO REMEMBER Eastman Kodak Company is making it easier for photographers to remember when they took their Kodachrome color slides. In the future all Kodachrome slides returned from Kodak laboratories will be stamped with the month and year they were processed. Another recently offered Kodak service will enable users of Kodachrome film to mail their exposed film directly to a Kodak laboratory for pre-paid processing and to have it returned directly to them by first-class mail. The service is based on the use of a special mailing bag customers may purchase through Kodak dealers.

NAVY AWARD Radio Corporation of America has received the prized Navy Certificate of Merit for development of the first completely automatic missiles firing and guidance system. The newly-created award is the highest civilian honor the Navy can bestow. The missile system cited by Navy Secretary Thomas S. Gates, Jr., is the TALOS Defense Unit, built at White Sands Proving Ground, N. M., by the Missile and Surface Radar Department of RCA Defense Electronic Products, Moorestown, N. J.

— GENERAL —

NEW BBC DEVELOPMENT The research department of the British Broadcasting Corporation has developed a new technique for the recording of TV pictures on magnetic tape, with accompanying sound. The system, called Vision Electron Recording Apparatus or VERA, was designed and built by a team of BBC engineers headed by Dr. P. E. Axon. It has been reported that recordings can be cut and the tape joined and played back as soon as the tape has been rewound, approximately six minutes. VERA differs from our system in that it employs a standard grade of magnetic tape, half an inch wide, of the type generally used for sound recording.

U.S. and U.S.S.R. COMPARED The Soviet Union's concern with military superiority at the expense of the standard of living of her people is brought into sharp focus in a recently released chartbook, "Economic Comparisons: USA and USSR: 1958 Annual Chart Survey," prepared by the National Industrial Conference Board. Current economic capacities, as well as future economic potentials of the Soviet system, are presented in relation to our own resources and performance. A copy of the chartbook may be obtained at a cost of $1.50 from NICB, 460 Park Avenue, New York 22, N. Y.

UNIVAC MANUAL As industry continues to adopt systems of automation to handle large amounts of data, automatic methods must be devised to prepare this data into graphical form. One method used is described in a recently published manual by Remington Rand, Division of Sperry Rand Corp., titled "Graphical Presentation with the Univac 120 Punched-Card Electronic Computer." Copies of this new manual, U-1471, can be obtained from any Remington Rand sales office or by writing to Remington Rand, Division of Sperry Rand Corp., 315 Fourth Ave., N. Y. 10, N. Y.

LONG LIVED Two stock model 8mm electric eye movie cameras under trial in a Bell & Howell laboratory have proved that the automatic exposure control would last the average home movie maker at least 3,750 years. This report is based on an estimate of shooting an average of 50 rolls of film a year in rapidly changing light that causes the electric eye mechanism to cycle completely 10 times every minute. During the 10 months of continuous testing, no signs of break-down of the electric eyes have been noted as yet.

"THE BIG PICTURE" This Department of the Army weekly television documentary now has the widest distribution of any syndicated TV series on the air today. The series originates from the Radio and Television Branch of the Army's Office, Chief of Information, and is produced by the Army Pictorial Center, Long Island City, N.Y. "The Big Picture" went on the air in December, 1951 and today, 338 commercial and educational video stations program it. It is seen in 287 cities and it is also aired on the 23 Armed Forces Radio Television Stations overseas.

TEARPROOF PAPER SACKS now can be made using a new stretchable paper called Kraftsman Clupack which was invented by Sanford Cluett, the inventor of the Sanforizing process. The paper is made of pulp treated by standard chemical methods, then placed on a rubber drying roll. When it snaps into normal dimension, the finished paper goes with it and the resulting bunched fibers will stretch. In a drop test the new paper outlasted conventional Kraft paper about 10 to 1 without tearing.

PARCELAIR SYSTEM is a new method of shipping by air, providing one to three-day delivery to any town in the U. S. at rates comparable to surface transportation. This new service is now offered by American Shippers, Inc., leading air freight forwarder and parent company. ParcelAir combines swift air transportation with truck or parcel post delivery, handling packages of any dimension up to 40 pounds each and being ideally adaptable to the electrical and electronics industries.

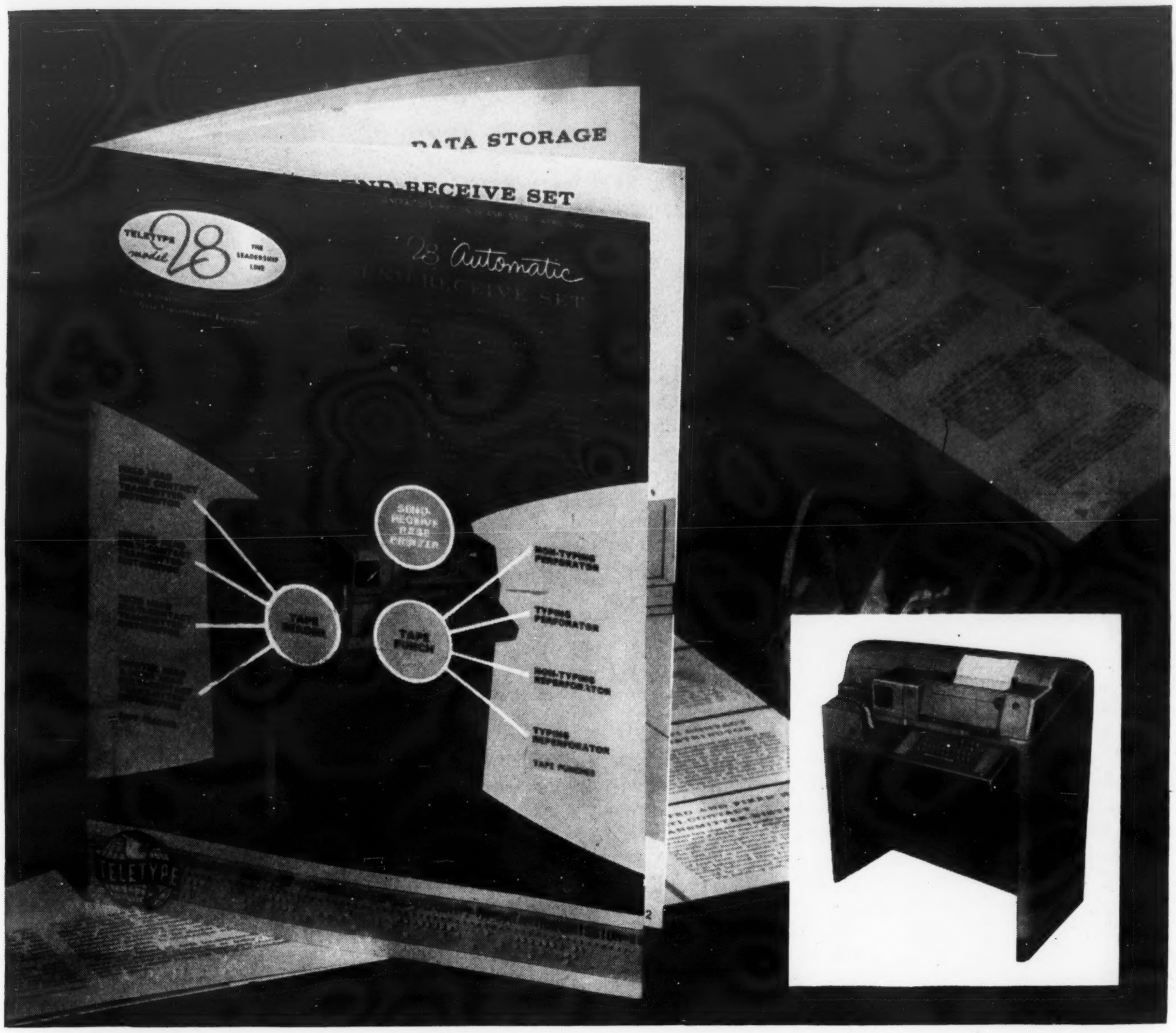
SPECIAL EVENTS:

SEPTEMBER 12-14: The Seventh Annual Chicago High Fidelity Show will be held at the Palmer House.

SEPTEMBER 30-OCTOBER 2: Admiral Arleigh Burke, Chief of Naval Operations and Mr. Clinton W. Blount, Vice President of Bakelite Co., Division of Union Carbide Corp., will address the Fourth Joint Military-Industry Packaging and Handling Symposium in Washington, D. C. Registration forms and detailed programs may be obtained from the Office of Naval Material, Washington 25, D. C.

OCTOBER 7-10: The Industrial Film & Audio-Visual Exhibition will be held at the Trade Show Building, 500 Eighth Avenue at 35th St., New York, N. Y. The National Visual Presentation Association and other associations are presenting this exhibition of current audio-visual equipment and techniques for conducting training sessions, sales meetings, visual presentations, advertising promotions. Several government agencies will be officially represented at the Exhibition. Further information may be obtained from: Industrial Exhibition, Inc., 17 East 45th St., N. Y. 17, N. Y.

DECEMBER 3-5: The Globe-Com-II 2nd National Symposium on Global Communications will be held at the Desert Ranch-Colonial Inn in St. Petersburg, Florida, being jointly sponsored by the IRE Professional Group on Communication Systems and the AIEE (Comm. Div.). September 30 is the deadline date for reserving exhibition space from: R. E. Lazarchik, Chairman, Exhibits Committee, Globe-Com-II, c/o Sperry-Rand Corp., P. O. Box 1828, Clearwater, Florida.



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PANEL DISCUSSION

FUTURISTIC MILITARY COMMUNICATIONS SYSTEMS

Panel Moderator

- COL. GEORGE P. SAMPSON, USA
  Chief of Army Communications
  Service Division, OCSigO

- CLIFFORD D. MAY, JR.
  U. S. Army Signal Corps

- COL. G. P. LERNER, USA
  U. S. Army Signal Corps

PART I

Colonel George P. Sampson, USA

THE FOLLOWING PANEL PRESENTATION CARRIES THE title of Futuristic Military Communications. Our objective is to present certain future communication requirements and an approach to meeting those requirements.

This presentation will be to isolate the area of discussion as military communications is a very broad subject. We will then briefly analyze this isolated area in light of what we have today and point up its deficiencies. This will lead to certain guiding factors for our futuristic system. Considering these factors, we will suggest approaches to the solution of the problems in providing such a system. Lastly, we will discuss our future system in relation to the military customer.

As a point of departure, just what is meant by military communications? At the risk of oversimplification this means all communications including commercial facilities which are used or are required to meet military requirements.

What then are the military requirements? The obvious answer is transmitting commands to subordinates in time for them to carry out a mission or receiving information from them upon which to base a decision. The means to do this may be air-to-air, air-to-ground, ship-to-shore, point-to-point and the like.

To place military requirements in proper context, however, one must remember that U. S. military elements, of one type or another, are involved in 73 countries of the world. In addition, there are the seas, islands and fly-over areas which represent military areas. These various elements and areas may have their local communications, but they cannot function independently of the rest of the armed forces throughout the world. I am sure we all appreciate the impact a given situation in one part of the world would have on other areas. Consequently, there must be a means of directing and coordinating these rather dispersed elements—each with its own communications. One must also remember that these dispersed elements are not fixed in a given area—many are mobile; this complicates the problem. It is this phase or part of military communications that we wish to discuss today—that is the world-wide communication means of controlling our world-wide forces.

We have stated that military communications are those required to meet the military requirements wherever military forces may be. We have also stated that the requirement insofar as this presentation is concerned pertains to long-haul strategic communications used for the direction and coordination of various military elements throughout the world. The next question, therefore, is: What type of transmission or communication service is involved? The answer to this is the gammit of message, voice, facsimile, data and underlying all is the one word "secure."

Now, how are we providing this service today and what is wrong with it?

Taking the message as an example, as today it represents the greatest volume of military communications, we find this system operates pretty much like this. A customer, or user, say in Europe, originates a message which is transmitted to a relay center in Europe where it is relayed to another relay center in the States where in turn it is relayed to the addressee. The user and addressee may be an element of a headquarters, an airplane, a missile base or a given individual at some location. Now this relay approach is employed commercially as well as militarily and seems rather simple and straightforward. One has to look more closely, however, to see the trouble.

At the user's location and at the addressee's location there are many manual operations which are time-consuming and therefore cause unacceptable delay. One can automatize the relay operation as has been done, but this does not speed up the operation from the originator's desk to the communications terminal connected to the relay center or from the other communications terminal to the addressee. One could provide direct circuits between all users if one were not confronted

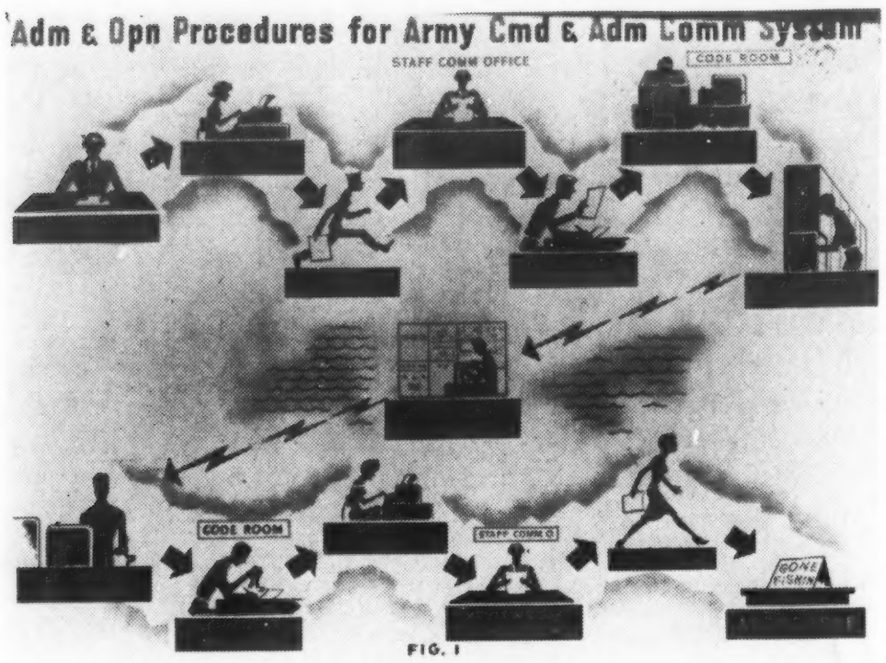


Figure 1

with such problems as money—people—frequencies. One might also provide the user with a teletypewriter or a facsimile device and let him transmit the message directly to the relay center thereby eliminating terminal operations as such. This principle is what we want to follow but remember this message we are discussing is classified so the user's equipment must be capable of so protecting. We need this capability without many black boxes and associated restrictive rules. See figure 1.

Why are we so concerned with speed? Why aren't the systems available today adequate? They are essentially of World War II and Korean War vintage and not geared to today's needs. Because of the potentials of nuclear warfare, the presence of missiles, the instability in certain areas of the world and all the possible political and military implications, our objective in this day and age must be for instantaneous communications—world-wide. We have a different set of rules today. In World War II the actions of the theatre commanders, such as Marshal Montgomery, did not influence battlefield operations for several days. Consequently, the requirement for speed in communications between their headquarters and battlefield elements were not so critical. This situation no longer prevails. We must have a means of getting decisions to and information from various parts of the world almost instantaneously. This is the major factor underlying our requirements for the future. That is speed. Speed, unto itself however, is not adequate because the system must also be sure—it must be positive—in other words, 100% reliable. This need for speed directs the first factor of designing our communications system of the future and that is user-to-user service which must be secure from user-to-user.

What else is wrong with our relay concept depicted on the chart in figure 1? The relay centers and associated communication facilities are concentrated on the ground and are sitting ducks. This is a problem which must be overcome with our future system—it must be flexible so as to withstand ravages of war.

In addition, with today's operations employing teletypewriters and human beings, errors creep into messages. There is no use having speed unless the message or the communications are accurate. That we don't have, but that we need and this is our second factor, that is, error checking and correcting techniques.

Considering other types of transmissions, that is, other than the message (data and the like), we find today that to provide each type of service requires many complex types of terminal equipment which is costly in personnel, in money and flexibility. One has to use specific communication channels for specific purposes and this inflexibility is not acceptable in an age crying for flexibility. This leads to the third factor that must govern our future system which is a standard language for all types of transmission and generally speaking, a standard channel to handle these communications. Because of commercial practice and our great dependence on commercial facilities to meet military requirements, it is quite logical to select as the backbone channel of our system the one with the telephone bandwidth. This basic channel, however, cannot meet all of the requirements so the system must be adaptable to a broader bandwidth channel.

The interconnection of these various areas of the world for the most part involves long-haul communications. What do we have to meet this need? For the most part, high-frequency radio and cables. In many areas of the world cables are nonexistent. One cannot escape the fact then that high-frequency radio is the basic long-haul communications means today for most areas of the world. In many areas even that is not available. Now, we have already stated that associated with speed, accuracy, and security our network must be reliable. Everyone present knows that considering only natural phenomena high-frequency radio does not meet this requirement so we have another factor—our system must consist of reliable transmission facilities throughout and this is a tough one.

To summarize the factors which must guide our communications system of the future, we find that: It must provide user-to-user service through automatic switching centers; It must be secure—this service without the security part is no good; It must provide automatic error checking and correcting—this without detracting from the speed requirement; It must automatically provide security—on-line encryption and decryption (we keep emphasizing this factor because generally it has no counterpart in industry); It must employ telephone bandwidth throughout and be adaptable to broader bandwidth channels; It must be adaptable to broadband requirements for various reasons; It must employ a standardized signal characteristic and rate throughout the system regardless of the transmission means employed—this is essential to flexibility; It must consist of reliable transmission facilities and equipment throughout; It must be compatible with various echelons of military systems and with commercial communications.

To summarize the summary it must be completely accurate, totally reliable, absolutely secure and it must be flexible to the Nth degree.

With this as the backdrop, we should now like to indicate from an application viewpoint how we visualize a system based on these factors must work. Mr. May will discuss a systems approach for a future global integrated military communications system.

PART II

Clifford D. May, Jr.

COLONEL SAMPSON, I BELIEVE THAT YOUR requirements can be met but not with the communication system that we have today. After listening to your talk, I am sure that it must be obvious to this audience that the military needs for a global military communications have changed considerably since World War II. Today,

we require a degree of flexibility, reliability, accuracy and security that were unheard of several years ago.

Unfortunately, however, the system with which we must meet these new demands is largely of World War II design. We have experienced considerable difficulty trying to adapt this system to keep pace with the demands of modern warfare. Now, after several years of study, we have concluded that engineering by addition is not the answer. Instead, we need a radically new system approach aimed at meeting the needs of the 1965-1970 era.

During my talk, I will describe in broad technical terms, a system approach for a future global integrated military communication system. The system to be described is largely within the current state-of-the-art to develop with few exceptions. I would like to emphasize, however, that system studies are still being conducted by the Army Signal Engineering Laboratories and the approach ultimately used may not be identical to the one described.

The military global communication system of the 1965-1970 era must meet the following four basic requirements that Col. Sampson previously discussed. Since these four terms are rather broad in scope, I would like to spend a moment explaining what is meant by each.

a. *Flexibility* means that our communication system of the future must be responsive to the needs of modern warfare by providing all the modes and speeds of communication required. The system must keep pace with the tactical forces by permitting a high degree of transportability and mobility. The system design must allow for flexibility through the use of alternate routes.

b. *Reliability*, of course, means that our system must function when we need it. Protection must be provided against electronic countermeasures and against physical destruction of facilities. Maintenance requirements must be held to a minimum to permit reliable maintenance with semi-skilled personnel. Logistic support must be simplified through a high degree of equipment standardization.

c. *Accuracy* means that information received over our system must be highly dependable. Possibly the required degree of accuracy can only be achieved through the use of an automatic error checking/correcting system. In addition, we must be able to verify the receipt of a message and, if necessary, authenticate the parties communicating.

d. *Security* is probably the most important requirement outside of the basic requirement for communications. The future system must have message-text, traffic-flow and routing information adequately protected. It must accomplish this with the minimum amount of classified equipment to reduce the physical security requirements and the personnel clearance problem. In addition, of course, the facilities must be provided with a high degree of physical security.

With these four basic requirements in mind, I would like to describe a concept of a futuristic military communication system capable of meeting these requirements.

Figure 2 illustrates the fundamental concept of UNICOM, The Universal Integrated Communication System. As you can see, the customers are connected to a device called the ACE, that is the Automatic Circuit Exchange. With the ACE, the customers' circuits can be automatically connected to each other for on-line communications between users. Radiac warning, weather reporting, airways control, as shown on this chart, and other similar devices are also customers automatically served by ACE. At least two degrees of precedence are provided—priority and routine. The priority calls take precedence over all routine calls and are switched *immediately* while the routine calls are switched in the order received by the circuit exchange.

In addition, the system concept provides for deferred messages. You will note the AMX on the chart. The AMX is an Automatic Message Exchange. Messages of deferred precedence and messages requiring automatic multiple distribution are handled by the AMX. In this case, messages, rather than circuits, are switched and no direct on-line connection is provided between customers.

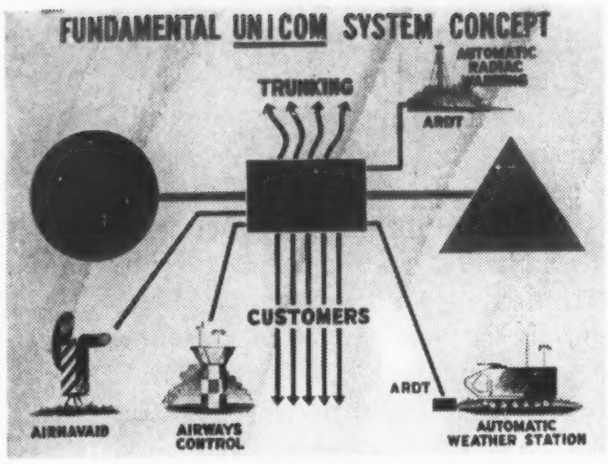
The symbol labeled ADSC in figure 2 is an Automatic Data Service Center. The ADSC is directly integrated with the communication system and provides many pre-programmed data processing functions upon demand from a customer. In addition, it renders periodic reports automatically to various customers through the Automatic Circuit Exchange.

Now I would like to discuss in further detail the makeup of the "black boxes" shown in figure 2. To best serve the needs of the system, two types of ACE's are required—one, a Local Automatic Circuit Exchange or LACE and one a Regional Automatic Circuit Exchange or RACE. Figure 3 shows the make-up of the Local Automatic Circuit Exchange.

The LACE is divided into a local switching section and a trunk switching section. Within a local area, interconnection between subscribers is provided through the local switching system. As you can see, the distribution system in the local area is protected with a security system, either electrical or physical, so that information of all classifications can be handled. Voice, teletype, data, facsimile and other services can be switched in the local area with equal facility. When it is necessary to switch into a long distance trunk, all information is encrypted in the on-line digital security device shown. Of course, when the basic information is analog rather than digital, an analog to digital conversion takes place prior to encryption. This is the purpose of the analog to digital converters shown on the slide. The principal means of trunking will be the telephone bandwidth channel. However, to meet the ultimate requirements, three grades of service will be provided by the trunking system—one grade handling an information bandwidth of approximately 3.5 KC—one grade handling approximately 50 KC and one grade handling 4.5 MC. This is the purpose of the converters and security devices labeled A, B and C on the slide.

At the bottom of the diagram you will note connections to the automatic message exchange. Messages originated by any other subscriber may be directed to the automatic message exchange for one of several purposes. First—deferred messages not requiring expeditious handling are processed by the message exchange; Second—the AMX may be used for processing messages directed to more than one addressee; Third—the AMX can be used for distribution of messages within a headquarters area; Fourth—the message exchange serves as a speed buffer so that low speed messages can be transmitted at higher speeds over the trunking system.

Figure 4 shows the block diagram of the AMX. Either high speed or low speed trunks are available into or out of the message exchange. When a low speed deferred message, such as a teletype message, is originated by a customer, it is transmitted through the LACE to this equipment where it is recorded magnetically. After the



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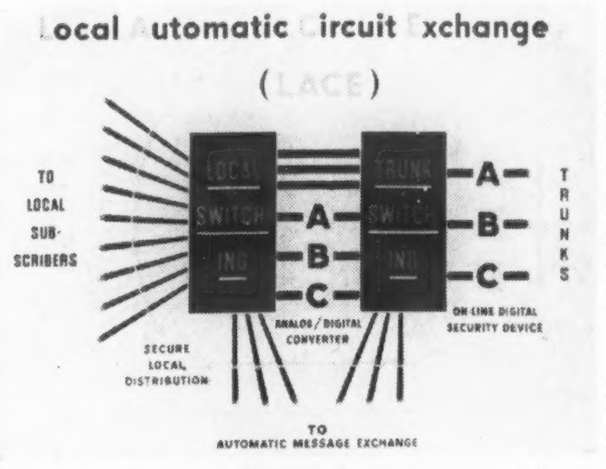

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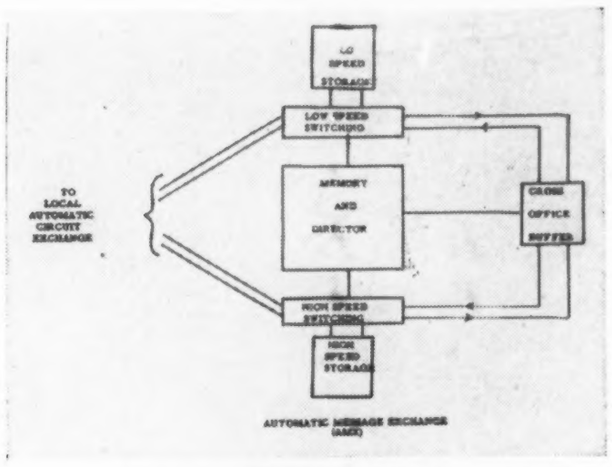
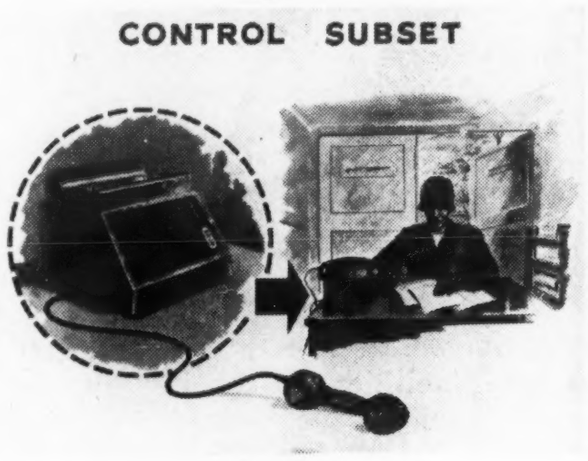


Figure 4



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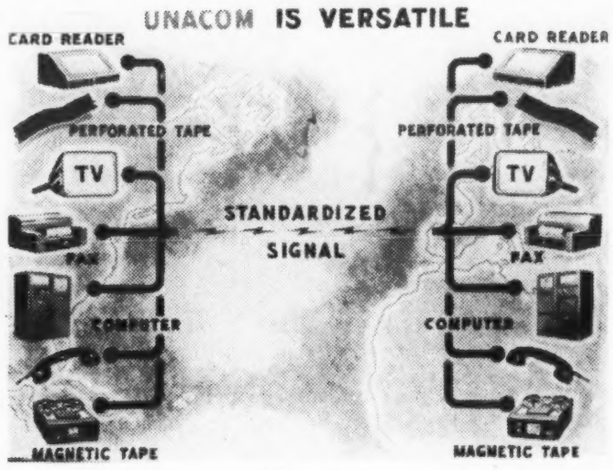

Figure 6

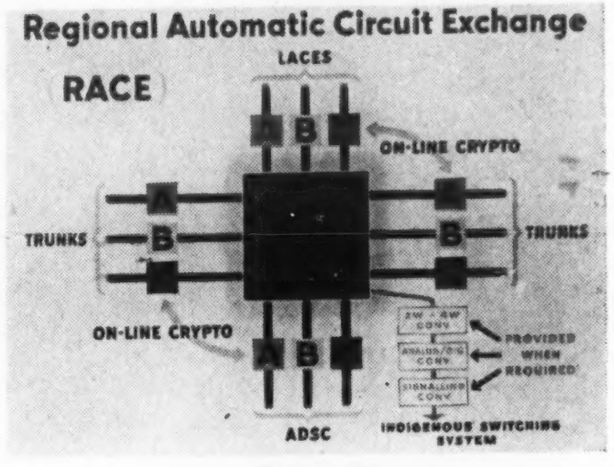

Figure 7

entire message is in storage, it is transferred cross-office at high speed to the high speed storage. The AMX then demands an outgoing trunk through the circuit exchange to the distant AMX. After trunk connection is established, the message is transmitted at high speed to the distant AMX where it is recorded and delivered to the local subscriber through the distant LACE. Time does not permit discussion of the other applications of the AMX; however, I am sure that the many possibilities are obvious to the communicators in the audience.

Before going further into the details of the switching system, let us back up and look at the hardware installed in the customer's office. The guiding objective of the design for subscriber equipment is to keep it simple and unclassified. Obviously, this precludes placing a classified cryptographic device at the customer's location. Instead, the local security depends upon a common security system. All classified devices are installed in the secure location of the Local Automatic Circuit Exchange. All subscribers are provided with a control subset (figure 5) regardless of the modes of communication for which they are equipped. As you can see from the photo, the control subset is a telephone-like instrument equipped with signaling keys, or possibly a dial.

The keys are used to transmit coded instructions to the switching center. These instructions consist of a routing-indicator, a precedence indicator and a mode-speed indicator. The routing indicator provides switching information regarding the called party. The precedence indicator advises the switching center of the priority placed on the call by the originator. The mode-speed indicator advises the switching center and called party of the mode of communications, such as voice, teletype, data or facsimile, and the speed, such as 100 words per minute or 1000 words per minute. All signaling is accomplished on a voice frequency basis. Distribution to the subscribers is on a voice frequency four-wire basis.

When modes of communication other than voice are required by a subscriber, additional terminal equipments are provided (figure 6). Punched cards, perforated tape, television, facsimile, on-line computers or magnetic tape terminals can be provided as shown on this diagram. Although not shown here, automatic page readers, which convert printed information into coded electrical information, are also required for use with this system. As this diagram illustrates, a common switching and security system is used to handle all of these modes. Regardless of the mode used, the control subset is always provided in addition to the required terminal to provide a means of signaling and coordination.

Now let us move back to the switching system again. You will recall that two types of automatic circuit exchanges were proposed—one a local exchange and one a regional exchange. We have discussed the local exchange. Now what about the regional exchange?

Figure 7 functionally illustrates the Regional Automatic Circuit Exchange or RACE. The RACE essentially is a long distance trunk switching system. As you will recall, all the trunks leaving the local exchange were all converted to secure digital trunks. Therefore, the trunks which must be switched by the RACE are all digital trunks. The information in the regional switching center is digital information in-the-clear. However, the information is re-encrypted prior to transmission over an outgoing trunk by the security devices shown on the diagram. The RACE accommodates the various grades of service with the devices labeled A, B and C.

Due to the unusual military requirements, it is expected that the greater part of our communications must be handled by a system of military design. However, a continuing requirement for compatibility with commercial systems is anticipated. The diagram illustrated the use of two-wire to four-wire converters, analog to digital converters and signaling converters to provide compatibility with indigenous civil systems. Whether this interconnection can be accomplished on a fully automatic basis is questionable. But, we foresee no difficulty in providing interconnection through a manual attendant.

The last major component of our future system is the Automatic Data Service Center or ADSC. Figure 8 shows the functional diagram of the ADSC. As you can see, the center consists of a switching section, a computer

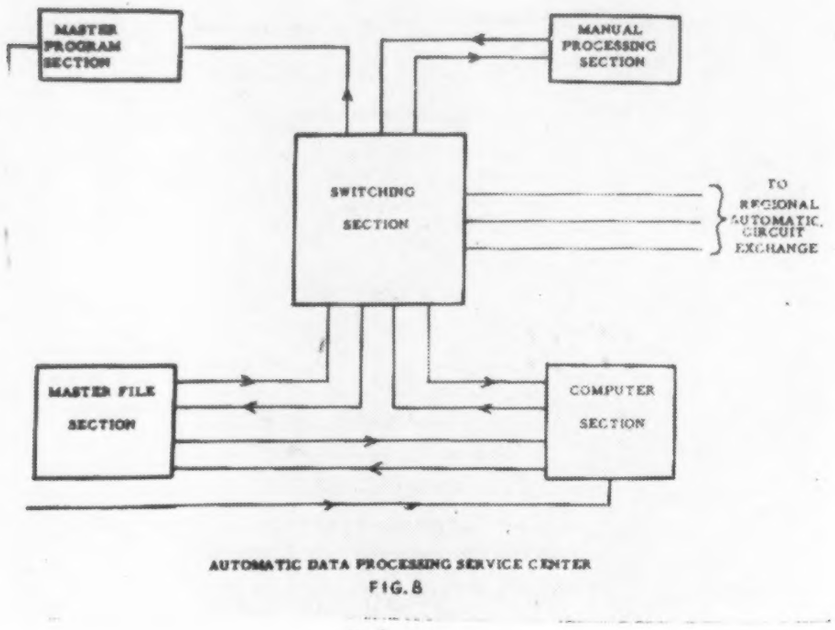

Figure 8

section, a master program section, a master file section and a manual processing section.

Information from many subscribers can be periodically transmitted directly to the Master File Section of the ADSC through its switching section. The ADSC, through the use of pre-programmed routines stored in the Master Program Section, can automatically perform periodic computations on information stored in the Master File Section or on information from a subscriber. The reports thus generated are automatically transmitted to predetermined subscribers through the automatic circuit exchange. For data processing operations not pre-programmed, a subscriber can communicate directly with the Manual Processing Section shown on the chart where the particular data problem can be manually programmed for processing by the computer. The trunks to the Regional Automatic Circuit Exchange are protected with an on-line security system (not shown) so that classified information can be received and processed without delay. The ADSC thus readily provides essential data services to all authorized subscribers through the integrated communication system. The extension of the integrated data services to higher and lower echelons will ultimately provide the degree of compatibility and standardization essential in a military system.

To complete the system picture, we must now tie together all of the "black boxes" that I have described with a reliable transmission system. Within a local area. the distribution from the LACE to the subscribers is effected largely with a secure cable. Security on this cable system is provided by a combination of physical security. masking techniques and cryptographic techniques. System design eliminates the need for classified equipment at the subscribers' location. In addition, a limited requirement for a simple secure radio relay system is anticipated to extend the secure local cable over greater distances to an outlying subscriber.

The transmission system required for long distance trunking must be capable of operating over: first—a continuous line of communication where the land, sea or sky is under control of friendly forces, and second—a non-continuous line of communications where friendly forces do not have control. In the case of the continuous LOC, trunking requirements will be met with land and undersea cable and radio relay systems. The radio relay systems may employ repeaters mounted on lighter-than-air, heavier-than-air or space platforms where necessary, in addition to conventional land repeaters. Tropospheric scatter will be used in some cases. The non-continuous LOC trunking requirements present a most difficult problem to solve. Of course, HF radio offers some capability in this area but the limited capacity plus vulnerability to countermeasures and natural phenomena make this mode unattractive. Radio relay employing space platform repeaters may be the answer. However, further studies are needed to confirm this. This is the most serious problem facing the global military communicator today. A great deal of emphasis must be placed on solving it if we are to meet the demands of modern warfare.

The last subject that I would like to discuss is the physical arrangement of facilities and the philosophy of material.

As you well realize, the design of today's global military system is such that facilities are concentrated in major installation such as illustrated in figure 9. The switching center serving a major headquarters is concentrated at a single location. The system control is also concentrated. Radio terminal facilities providing major long distance trunks are usually installed at a single location. The vulnerability of such concentrated facilities is obvious. Our system of the future must be designed for dispersal (figure 10). We cannot permit an entire headquarters complex to depend upon highly concentrated facilities. Our switching and trunking facilities must be dispersed providing blast and CBR protection. This artist's sketch (figure 11) shows a typical fixed radio pod installation which provides the transmitting end of a long distance trunk. The pod is unattended and remotely controlled from one of the switching centers. Alternate equipment is provided to insure continuity of operation. In addition to the fixed type pods, as shown in this diagram, we have requirements for similar installations in transportable shelters.

The maintenance and training requirements for the future system will be held to a minimum. Reliability will be such that the unattended facilities will be capable of operating for six months or more without maintenance. Maximum standardization and modular construction will be used to simplify maintenance and training. Automatic fault location will be exploited where practicable. All major components of the system will be designed for operation in a military environment.

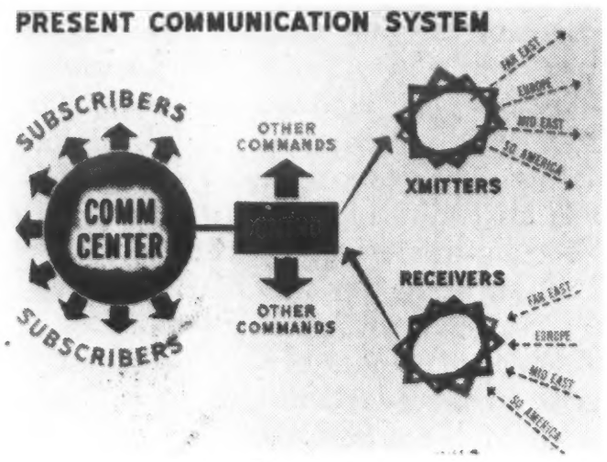

Figure 9

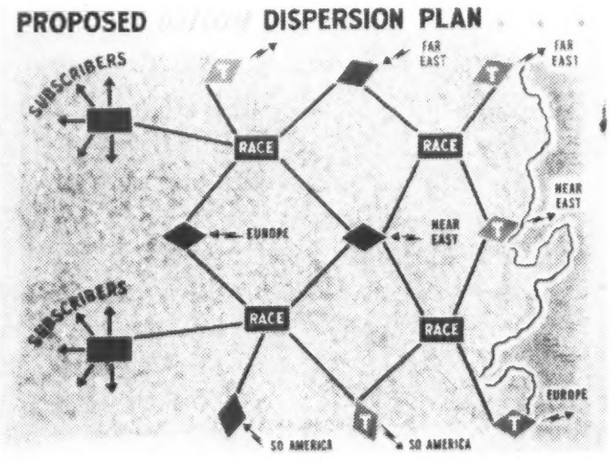

Figure 10

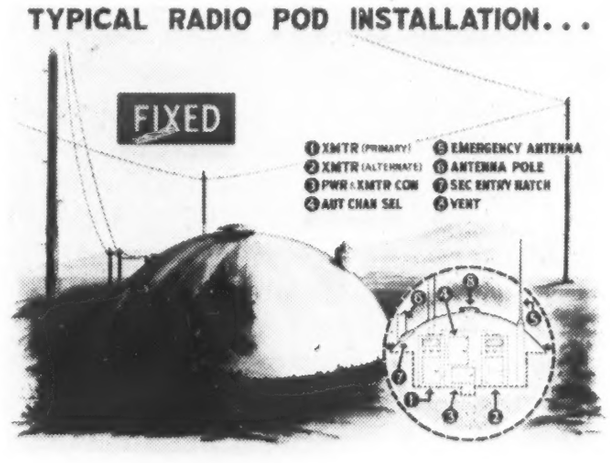

Figure 11

the primary link in a Telemetry System is

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• To the right in the photo are pictured the Nems - Clarke Type 1401A Receivers in telemetry racks aboard one of the telemetry picket ships. These vessels are used in down range support at the Air Force Missile Test Center PAFB, Florida. Ship installation was made under Pan American World Airways subcontract 57-5 by Centronix, Inc., Cocoa, Florida.

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This concludes my technical discussion of UNICOM, the Universal Integrated Communication System. It is recognized that the goals visualized cannot be achieved overnight. Ten or more years of intense research and development may be required. We have started on such a program. We optimistically expect to provide a system which will be responsive to the demands of global warfare in the 1965-1970 period.

Col. Lerner—How are you going to use the system that I have described to meet your future needs?

PART III

Colonel G. P. Lerner, USA

MR. MAY, I APPRECIATE YOUR RAPID DESIGN OF THIS futuristic communications system. Before I show you how I will use it, let's look at its geographical scope and magnitude.

Shown in figure 12 on the European continent, we have a large strategic force deployed in battle array. On the continent of the U.S. are the supporting activities needed for the overseas forces. The dots indicate military organizations whose titles are shown. Each dot represents hundreds of customers for this futuristic communications system.

On the European continent, the combat forces are commanded by Task Force Headquarters. There are several task forces in the European continent but only one shown here. All of these task forces are commanded by Theater Headquarters. This Theater Headquarters and the task forces draw food, clothing, ammunition and supplies from the depots. The depots have their supplies shipped in from the U.S. through the port. The port also brings in personnel for the personnel center and as replacements for the task force.

There is more than one of these major fighting fronts. As in World War II, we still have considerations on the European continent and in the Pacific. So as I describe how I will use this communications system you should visualize the same conditions for the Pacific and other theaters as needed. All military operations, regardless of how many or where fought, will still be controlled by one group of military men and this is the Joint Chiefs of Staff. They must have a major communications center with links to all world-wide commands.

Let's go back to the European Theater shown in figure 12. This has been a very active theater and our forces have been successful. This action started as a border crossing operation. Early warning of this was immediately called through to Joint Chiefs of Staff over the universal integrated communication system. The enemy is retreating. The theater commander is about to take advantage of this situation.

Shown in figure 13 is the communications system which was installed to support the successful heavy fighting.

The light rectangles are the Regional Automatic Circuits Exchanges which Mr. May called RACES. The RACE in the bottom center and its satellite switching centers, shown in dark rectangles, are called the Local Automatic Circuit Exchanges (dubbed LACES) and serve the Theater Headquarters, the Depot and Port Complex. The RACE at the right, with its satellite boards the LACES, serves the Task Force Headquarters and supporting forces. The RACES at the upper left serves the personnel and administrative activities.

All these switching centers are interconnected to form a system. They use land line, VHF, microwave, forward propagation scatter, and high frequency radio. The European continent is linked to the U.S. through international submarine cable, high frequency radio, satellite radio relay communications and lighter than air communications platforms. The entire system provides security for all classified traffic.

Now that you have seen the scope and magnitude of the system, here is how I will use it.

Now, I am at Task Force Headquarters. The phone rings and I am ordered by Theater Headquarters to be prepared to seize two new objectives deep in the enemy rear. When informed of this, the task force commander asks that we quickly prepare a written reply with a simple sketch of how we will carry out these orders asking that an additional battle-trained airborne division be assigned prior to our attack. This is rapidly sent to Theater Headquarters via slowed-down video by dialing this service through the control subset.

Theater Headquarters agrees with the need for the air-borne division. It is essential to the success of the operation that the attack be launched within 24 hours so this request is rapidly passed on to the Joint Chiefs of Staff. They consent and send the division on its way.

The supply officer at Task Force Headquarters dials his control subset to query the automatic data service center. He wants to know how much ammo and food an air-borne division gets for their battle allotment and if we have enough on hand to supply this. Back comes the answer all typed out on his teleprinter.

The theater commander dials the task force commander on the control subset and asks for a conference on the proposed attack. The staffs of both headquarters assemble in their respective Strategic Operations Centers and through secure closed-loop T.V. the task force commanders explain how the operation will be conducted. To clear up questions on terrain the task force operations officer dials his control subset and brings in the air-borne T.V. camera flying over the area in which the attack is to be launched. This is picked up both at Theater Headquarters and Task Force Headquarters.

(Continued on Page 59)

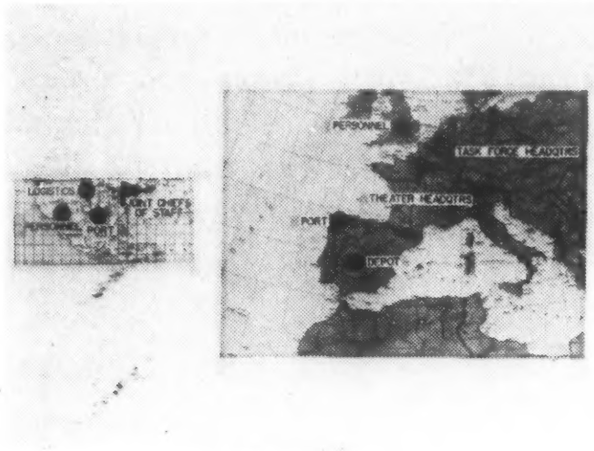

Figure 12

Each dot (in figure 12) represents hundreds of customers for this futuristic communications system. The dots indicate military organizations whose titles are shown. The light rectangles (in figure 13) are the Regional Automatic Circuit Exchanges. The dark rectangles represent Local Automatic Circuit Exchanges.

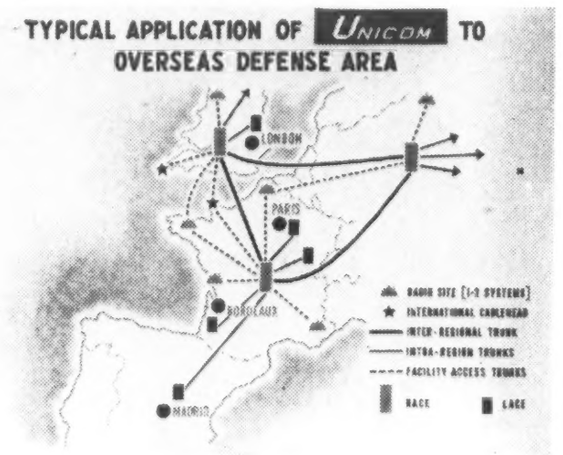

Figure 13

AFCEA Member Registered As Professional Engineer

Brigadier General Kenneth F. Zitzman and ten other members of the Faculty and Resident Student body of the Industrial College of the Armed Forces recently appeared before the District of Columbia Board of Registration for Professional Engineers and were certified for registration as professional engineers. All have both engineering degrees and years of experience in particular engineering fields.

The Industrial College of the Armed Forces, located at Fort Lesley J. McNair in the District of Columbia, is under the direct supervision of the Joint Chiefs of Staff. The college has the mission of preparing senior military officers and selected civilian personnel for high-level assignments within the national and international security structure. The primary field of study is the economics of nations in both peace and war.

Certified for registration were:

Brig. Gen. Kenneth F. Zitzman, USA (EE)
Capt. John D. Burky, USN (CE)
Col. Robert H. Curtin, USAF (CE)
Col. Howard K. Eggleston, USA (CE)
Col. George Kumpe, USA (CE)
Col. Walter P. Leber, USA (CE)
Col. Robert W. Love, USA (CE)
Capt. Edward E. Saunders, USN (IE)
Col. Wilfred H. Tetley, USAF (M&EE)
Col. John E. Walker, USA (CE)
Lt. Col. John W. Baum, USA (CE)

AFCEA New Group Member

Jerrold Electronics Corporation

The AFCEA recently welcomed the Jerrold Electronics Corporation to its group membership. This manufacturer of electronic equipment and systems is located at 15th Street and Lehigh Avenue, Philadelphia 32, Pennsylvania.

Members of the firm who will be company representatives in AFCEA are: Fred Lieberman, Manager, Military Sales; Max Kraus, Manager, Construction Division; J. Hastings, Manager, Mid-Atlantic; J. Roseberry, Mid-Atlantic, Military; Lee Druckman, Manager, Western Division; Lee Zemnick, Regional Manager; L. Waelterman, Regional Manager; William Miller, Sales Manager; J. Stillwell; J. C. Lauer.

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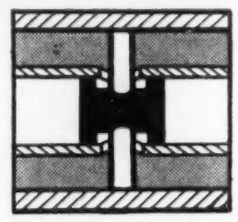
Diagramatic of reactance compensated insulator

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UHF SERIES "900" service tested reactance compensated inner conductor support

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all EIA (RETMA) standardized

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A comprehensive coverage of timely subjects relating to the state of the art of communications, electronics and photography was revealed in the twelve professional papers presented at the 1958 June Convention. An interested audience was enlightened by these papers which were presented by select and outstanding spokesmen representing industry and the military. The following four papers are the first in a series to be published by SIGNAL. Other papers will follow in subsequent issues of the magazine.

PROFESSIONAL PAPERS

The professional papers presented on the following pages are: / Weather Radar, A Tool for Combat by Dr. D. M. Swingle, Chief, Meteorological Techniques Branch, Meteorological Division, U. S. Army Signal Research and Development Laboratories, Fort Monmouth, N. J. / Channelizing Frequency Modulated Scatter Communication Systems by Thomas A. Combellick, Manager, Government Sales, Eastern Area, Lenkurt Electric Company, Inc. / The Modern Air Force, Its Challenge to Communications and Electronics Research and Development by Colonel Gordon T. Gould, Jr., USAF, Ass't for Electronic Supporting Systems, Deputy Commander, Weapon Systems, Air Research and Development Command, Andrews Air Force Base / The Product Review Program and the Need for It by William J. Laverick, Director, Production Engineering Department, U. S. Army Signal Equipment Support Agency, Fort Monmouth, N. J.

RAdm. Gordon Caswell, USN (Ret.), Chairman,

Professional Papers, introduces the program.

Weather Radar, A Tool for Combat

by DR. D. M. SWINGLE, USA Signal Research & Development Lab., Ft. Monmouth

DURING WORLD WAR II THE RAPID DEVELOPMENT OF microwave radar led to the discovery that such equipment had feasibility for detecting precipitation in the atmosphere. As a consequence, the U.S. Army Air Force requested the Chief Signal Officer to develop a weather radar capable of detecting thunderstorms at a range of not less than 200 miles. The first radar designed specifically for weather surveillance was developed during the period 1945-1950 and was procured for use by the U.S. Air Force during the early 1950's.

Today the U.S. Weather Bureau operates a network consisting of approximately 60 modified military radars of varying sensitivities and capabilities. In addition, the Air Force and Navy operate a network of 29 of the higher-sensitivity storm detection radars—Radar Set AN/CPS-9 developed by the Signal Corps Laboratories. As a consequence, there is fairly good weather radar coverage over most of the eastern and central United States. Coordination between the several Federal Government agencies operating weather radar equipment has resulted in a standard set of procedures for observing and reporting weather echoes. These are consolidated by the Radar Analysis and Development Unit, U.S. Weather Bureau, Kansas City, Missouri, and disseminated hourly by teletype to interested weather stations. This system is far better than anything which has been operated in the past although it is obvious that it cannot hope to exploit or even handle the great mass of detail which the weather radar net now in being is capable of generating on such things as a wave cyclone or a summer afternoon squall line. Perhaps some day the requirements for detailed forecasting will require the establishment of a facsimile or other picture transmission system which will permit the complete detail observable at each station to be transmitted into regional or national analysis offices.

Recent studies tend to support the view that in time meteorology may grow sufficiently accurate and develop sufficient understanding of the smaller scale atmospheric processes that such collected reports will be regarded as indispensable inputs to the forecasting process.

The weather radar data transmission problem has been looked at by a number of people with the result that numerous code systems for teletype transmission have been developed, as well as several methods of picture transmission. One of the latter, Facsimile Set AN/GXC-4, developed by the U.S. Army Signal Engineering Laboratories, was designed specifically to accompany Radar Set AN/CPS-9. It will accept photographs taken on regular Polaroid film of any of the AN/CPS-9 radar scope presentations and will reproduce these as Polaroid prints or transparencies after transmission over a wire or radio facsimile circuit. Other systems such as microwave link or otherwise slowed down or partially encoded video, television, etc., have been either considered or experimented with.

Aside from the problems of data transmission, which is the central problem preventing a larger scale analysis and synthesis of weather radar data, considerable work has been done in further investigations of the nature and significance of radar echoes. The most active of the radar organizations conducting this work have been the Massachusetts Institute of Technology, the University of Illinois, Texas A&M College and McGill University in Montreal, Canada.

The latter organization has, for instance, recently created an experimental constant altitude plan position indication known as CAPI. Such device could permit one to study the character of the precipitation process at various levels in the atmosphere and thus obtain a superior understanding of the over-all meteorological situation. Although most radars now in being are ill suited to this type of display, it offers interesting possibilities for future development, particularly since this type of analysis is that most often used by practicing meteorologists.

At Texas A&M College, Professor Ligda has supervised a research study which assembled the weather radarscope photographs from a large number of radars to obtain consolidated weather radar echo maps covering large sections of the country. It appears very clear that much more data are available at the radarscopes than are now being transmitted and interpreted by the consolidation center. If the data are further multiplied by division into altitude slices, it becomes very clear that a most powerful tool for analyzing meteorological situations, including precipitation processes, awaits only adequate means of transmission of the data.

At the University of Illinois, personnel of the Illinois State Water Survey Division have been actively pursuing a research program directed toward a quantitative evaluation of precipitation from radar echo intensities. Their reports have been fairly extensive and indicate that radar may be used for obtaining precipitation estimates over large areas where numerous rain gauges might not be feasible or desirable. This work has great potential for maintaining battlefield surveillance of precipitation and its effects on mobility in both friendly and enemy areas.

An additional phase of their work has included detailed analysis of the smaller scale features of the weather. This has been principally in connection with the detailed analysis of the 1947 Thunderstorm Project data. In this analysis they have shown that generally smaller scale circulation patterns having persistence, organization, continuity and presumably predictability, exist even down to scales detectable or observable by stations separated by average distances of only two miles. This is, of course, the sort of resolution which one normally expects of a weather radar. The application of such finer detail to consideration of weather as it occurs on the Army's scale of operation is evident.

At the Massachusetts Institute of Technology, work on the analysis of the radar echo in terms of intelligence contained in the fluctuation of the echoes and in the analysis of the radar data in terms of the precipitation process has been in progress.

The work of these and many other organizations working in and/or adjacent to weather radar have been most effectively presented through the medium of the weather radar conferences which have been sponsored by the more active organizations in association with the American Meteorological Society, Institute of Radio Engineers and the American

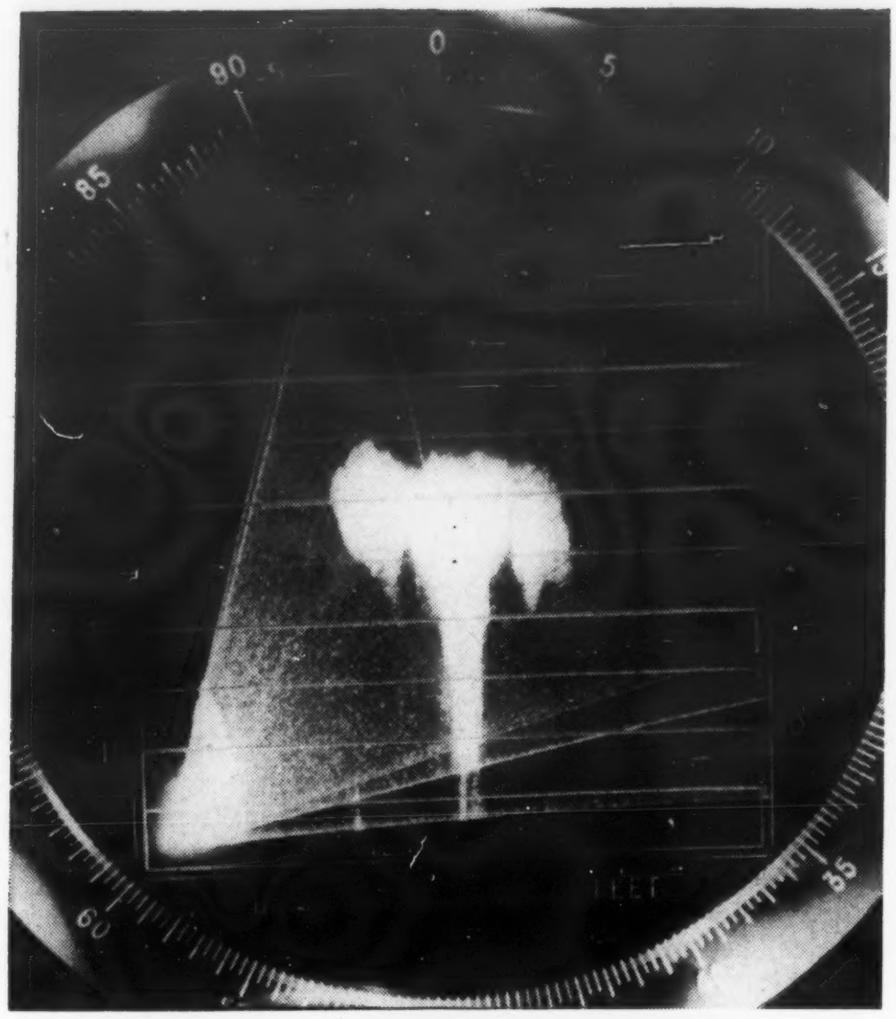


Figure 1

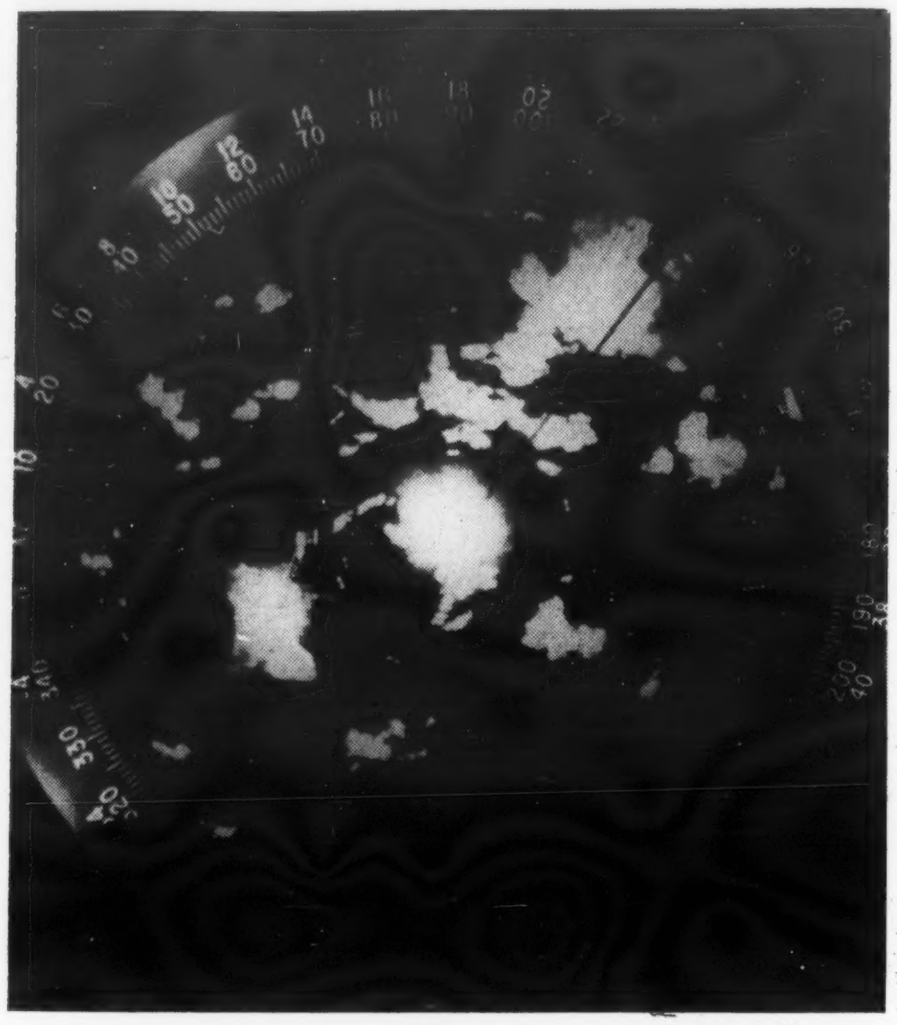


Figure 2

Geophysical Union. To date there have been six weather radar conferences. The intense interest in this field is clear when one notes that both the 1955 conference, sponsored by the Signal Corps, and the 1957 conference, sponsored jointly by the Massachusetts Institute of Technology and the United States Air Force, contained 55 research papers.

The first conference was an informal meeting sponsored by Massachusetts Institute of Technology and held in Cambridge, Massachusetts, in 1947. In 1951, the second Weather Radar Conference was sponsored by the Illinois State Water Division at Urbana, Illinois. In 1952, the 3d Weather Radar Conference was held at McGill University. In 1953, the 4th Weather Radar Conference was held at the University of Texas and sponsored by the American Meteorological Society, Institute of Radar Engineers, and URSI. In 1955, the 5th Weather Radar Conference was held at Asbury Park, sponsored by the U.S. Army Signal Engineering Laboratories and the American Meteorological Society. In 1957, the 6th Weather Radar Conference was held in Cambridge, Massachusetts, under the sponsorship of the Air Force Cambridge Research Center, the Massachusetts Institute of Technology and the American Meteorological Society. The 7th Weather Radar Conference is tentatively scheduled to be held during November 1958, at Miami, Florida.

As noted above, the first conference was relatively informal and resulted in no formal proceedings. The succeeding conferences have each been blessed with some form of proceedings recorded and published for limited distribution to the conferees. The American Meteorological Society has created a weather radar committee whose membership has changed from time to time. Probably the single most important function of this committee has been to arrange for the orderly continuation of these weather radar conferences which have brought together the leading researchers in the field resulting in a most profitable cross fertilization of ideas.

I would like to turn now to a more recent application of weather radar. Weather radars have been particularly useful for observing large cloud masses which form showers and thunderstorms. One might reasonably ask whether it can also detect the new and more ominous cloud resulting from atomic warfare. This is the application of weather radar to the detection of atomic explosions.

From our discussion above, it can be seen that there exists a network of weather radars in the country which is capable of providing rather good coverage for the observation of thunderstorms across most of the United States. Radar Set AN/CPS-9 was developed with the specific goal for the detection of thunderstorms at range of at least 200 miles. Until recently no direct observations were made of a new type of atmospheric cloud, namely that created by an atomic explosion. During recent atomic tests, observations have been made of both kiloton and megaton explosions using Radar Set AN/CPS-9 as well as other radar equipments.

One might expect that a set such as AN/CPS-9, which was designed to detect the aggregate echo from billions of tiny water droplets existing in a natural rainfall, might have fair capability for the detection of the water droplets, ice crystals and other particulate matter contained in an atomic cloud. Most of these particles would be small enough, that is, less than approximately a third of the wave length in diameter, that the Raleigh detection would apply. Figure 1 shows one such cloud at approximate stabilization time as presented on the range-height indicator of the AN/CPS-9. Here it extends to 70,000 feet and is centered at a range of 25 miles. Figure 2 shows the echo created by such a cloud on plan position indicator thirty minutes after shot time at azimuth 350°, 25 miles.

Although in some cases, echoes could be detected for a long period of time, it is not clear at this time whether these observations have significance for fallout prediction or for such purposes as civil defense. It may be suspected that such long persisting echoes consist principally of water substance particles in liquid or solid form which are falling or are possibly supported on up-drafts and which may not include the entire volume occupied by contaminated particles. Even if this be so, then the radar echoes may be useful for identifying the original bomb location site in yielding information as to the rate of growth, dimensions of the atomic cloud, etc. Existing radars are not well adapted to tracking radioactive fallout to the ground. A much more sensitive radar, however, might conceivably have such capabilities.

Much more work remains to be done in the analysis and understanding of the radar observation of atomic clouds. Similarly, its full exploitation in detailed weather support for combat forces and for mobility assessment will require much additional effort. However, these are merely illustrative of the many applications which I am very certain will continue to be found for weather radar data in its exploitation for support of the Army during the atomic age.

Channelizing Frequency Modulated Scatter Communication Systems

by Thomas A. Combellick, Lenkurt Electric Company

THE TASK OF CHANNELIZING tropospheric scatter radio systems has several unique aspects. Design of the channelizing equipment depends partly on the special radio equipment used and partly on the path characteristics. Some uses of tropospheric scatter also impose requirements on circuit design that differ from those imposed by point-to-point communications. The specific aspects of channelizing equipment that may require special consideration are: (1) per-channel power delivered to the transmitter, (2) noise-reducing circuits and techniques, (3) signaling methods, and (4) channel level regulation. Each of these has an important bearing on over-all system performance.

An outstanding characteristic of fm scatter systems is the high cost for each decibel of signal-to-noise ratio. Very large transmitter powers, huge antennas, low-noise pre-amplifiers, diversity reception and the like are all expensive devices or techniques necessary to insure adequate radio performance and reliability. With this unusual amount of attention given to the radio equipment, the channelizing equipment must also be closely scrutinized in every respect. Generally, it is necessary to provide features not usually found in channelizing equipment for conventional communication systems.

Another important characteristic of fm scatter systems is that the total rf bandwidth must be kept narrow. In "line-of-sight" systems, wide bandwidths may be used because additional gain to support the wider bandwidth can be bought relatively easily by the use of larger antennas or more transmitter power. But in scatter systems, these techniques must be used to their economic limit just to obtain a minimum acceptable radio circuit. No margin is left to compensate for wide bandwidths or deficiencies in the channelizing equipment.

To achieve a narrow rf bandwith, the output frequency band of the channelizing equipment should be as narrow as possible and as low in frequency as possible. The standard way of accomplishing this is by the use of single sideband suppressed carrier equipment with closely spaced channels.

A propagation peculiarity of a scatter circuit is continual rapid fading of the multipath variety. This requires the regulation of channel level to prevent adverse effects on message and data circuits. Aircraft in the transmission path may cause the fading rate to be in the order of 10 fades per second. If the radio equipment is not capable of maintaining a constant output level during this type of fading, additional regulation must be included in the channelizing equipment.

Many features of channelizing equipment that require special attention in engineering a scatter system are inter-related. Improvements in one may have an adverse effect on another.

It is very important that the input signal to radio equipment be composed of message information to the greatest extent possible. Single sideband suppressed carrier channelizing provides a signal that is all message information except for status signals and carrier leak. Status signals, such as signaling tones, should be present —if at all—at a very low level. In many cases, it is advantageous to remove them entirely when their presence indicates only the duration of a particular condition, and to transmit them only to indicate a change in the condition. Complete removal of these signals, however, will pose other problems such as channel regulation.

Other unwanted signals, such as carrier leak, should be maintained at the lowest level technically feasible. Carefully balanced modulators are generally used to reduce this contribution to radio loading to a minimum.

It is common practice to take full advantage of the periods during which only a few channels out of the total number are in use by allowing these active channels to modulate the transmitter fully. This strategy reduces the average channel noise by making large improvements under lightly loaded conditions even though it does not improve performance at those times when a large number of channels are busy.

The rapid deep fading to which scatter systems are susceptible makes it imperative that the load be composed almost entirely of message signals. To maintain communication between terminals during deep-fade conditions, it may be necessary to remove all but a single voice or telegraph channel and load the transmitter fully with this single-message channel. Thus, when only one channel is active it will deliver to the radio the same peak voltage made available when all channels are active, so that the active channel signal-to-noise ratio is considerably increased.

Noise Reducing Circuits

Noise originating in the channelizing equipment should not contribute to the over-all channel noise in the system. Channelizing equipment noise (when connected back-to-back) should be well below the total permissible system noise so that radio system noise limitations may be eased as much as possible. Two techniques are used to reduce the effect of radio equipment and path noise. These are volume compression-expansion devices (compandors) and frequency emphasis and de-emphasis.

Compandors, when used on scatter circuits, provide the advantage of maintaining a smaller dynamic output range per channel and improving the noise and crosstalk characteristics of the system. The compression and expansion ratios used vary between 2 to 1 and 10 to 1, depending on the application. However, it should be noted that by the nature of the expansion process any level variations incurred in the radio are multiplied by the expansion ratio. This is one of the features requiring a balance of interacting factors.

Some early experiments indicated that compandors were not useful during periods when the fm signal was fading in and out of the threshold condition. More recently, it has been found that, working in conjunction with a radio squelch circuit, the compandor is extremely helpful under threshold conditions.

Sometimes an expansion ratio smaller than the compression ratio is chosen. Typically, a compression ratio of 10:1 and an expansion ratio of 2:1 may be chosen. Such compression-expansion provides nearly constant per channel loading of the radio. After compression, the rms power of quiet, average and loud talkers differs at the most by 2 db. Also, the level of the quiet talker has been improved such that during marginal conditions his speech will be intelligible when it would not have been otherwise.

Various other types of special treatment are available. One of these is per-channel emphasis and de-emphasis. By emphasizing the higher frequency energy of speech, greater intelligibility is achieved and improvement in signal-to-noise ratio is

obtained. This is because the upper voice frequencies which convey most of the intelligence are made relatively louder. De-emphasizing at a lesser rate at the receiving end will preserve the added intelligibility but will tend to change the "quality" of the speech (the listeners' ability to recognize the identity of the speaker). When intelligibility is the primary concern, such as for military applications, this change in quality is acceptable. For most commercial applications, it is not.

The signaling method chosen depends strongly upon the type of plant into which the system is to be integrated. Out-of-band, tone-off-while-idle signaling has the advantage of not contributing to radio-system loading while in the idle condition. However, this method is somewhat susceptible to false seizure by noise during periods of deep fades on the radio circuit. Frequency-shift signaling of this type is usually more immune to noise than the on-off type.

In-band, single-frequency signaling may be common in the existing plant and thus attractive for use on the channelizing equipment for scatter-communication systems. The low-level idle circuit tone commonly used with this type of signaling contributes some to total system loading, being about equal to "full time" frequency shift signaling systems. The loading is not significant, however, until the number of channels in a system approaches 60 or 70.

"Full time" frequency shift signaling provides the greatest reliability. This method has the further advantage that the signaling tone may be used for channel-level regulation. This has been found highly desirable on many conventional circuits. If full time frequency shift signaling is used, any means to improve average performance by maintaining a constant load on the radio equipment cannot be made fully effective because the presence of the signaling tones will contribute continuously to the load of the radio and reduce the maximum usable signal power for channel intelligence. However, channels may still be disconnected during periods of deep fading in order to improve the performance of those remaining. This signaling system has been found very satisfactory for systems of 24 channels or less.

Again, the type of operation to be selected depends upon the over-all system into which it is to be integrated. In many commercial telephone systems, it is necessary to be able to talk over a circuit whether it is in the on-hook or the off-hook condition. With this restriction, the aforementioned methods of signaling include all the important practical ones. But, if this restriction can be removed, as it can in many military and special installations, then channelizing equipment arrangements may be made that will greatly improve performance.

If answering (off-hook) supervision is always presented before conversation takes place, it is possible to provide regulation during conversation and yet during the idle condition remove all tones that might contribute to radio-system loading.

If tones are removed during the idle condition, the regulating tone can be controlled by the compressor and then used to control the expandor rather than a receiving regulator. This gives a better compandor tracking and, most important, insures that channel-level variations are not multiplied by the expansion ratio.

Tone-controlled compandors are extremely versatile. Not only does the expandor control provide automatic channel regulation, but the regulating tone can be used for frequency-shift signaling. This substantially reduces over-all circuit complexity while simultaneously providing the most reliable signaling system available.

Various arrangements of standby channelizing are used in scatter systems because of the usually extreme reliability requirements. Switching can be accomplished on a per-channel basis or by groups of channels. On the transmitter side, it has been found most desirable to switch between 12-channel banks or 24-channel groups on failure of the common equipment. On the receiving side, it is possible for the radio output to feed both the active and standby channelizing equipment in parallel, thus eliminating the need for switching. However, determining which circuits are handling traffic may create maintenance problems which make it advisable to switch both transmitting and receiving sections on an over-all basis. Care must be exercised in designing the switching, sensing and alarm facilities so that their complexity does not outweigh their usefulness. In general, the standby and switching facilities are designed to meet the over-all system reliability requirements and are usually special for each application.

Unitized construction should be used so that channels and common equipment can be replaced under adverse field maintenance conditions. Frequency determining portions of the channel units should be contained in the equipment shelf or should be plug-in sub-assemblies so that any channel unit may be substituted for any other.

At best, tropospheric scatter systems tend to be marginal in performance. Channelizing equipment for them should not contribute significantly to system noise, distortion, loss or crosstalk. Indeed, if possible, it should tend to make up for some of the deficiencies in the radio equipment and propagation path.

To meet these requirements, channelizing equipment for scatter systems should have features not ordinarily found in wire-line or conventional line-of-sight systems. Some of the desired features are not yet incorporated in any standard equipment. Others are found in only certain types. In any case, when the over-all performance and reliability requirements have been established, the radio and channelizing equipments should be considered as a system with the available features of both coordinated in every detail.

The Modern Air Force, Its Challenge to Communications and Electronics Research and Development

by Col. Gordon T. Gould, Jr., USAF, Air R&D Command, Andrews AFB

THE SCIENCE OF MODERN WAR, the science of committing forces and the employment of individual weapons, has become quite complex due to the range and tremendous speeds that have been obtained in modern weapons.

During the past fifty years the U.S. Air Force has progressed into the "Jet Age" and is in the initial phases of the space era. Weapons have been developed with greater and greater speed, range and altitude capabilities to maintain superiority in the various mission areas assigned to the Air Force. Methods of employing these weapons and the concepts of modern warfare have evolved as a natural result. Functions that had been performed manually now require extensive communication-electronic environments and automation to permit the commander to utilize the weapons effectively.

In air defense as an example, the operational employment of interceptors, the problems of finding and

identifying the enemy target, and determining an intercept course have far surpassed the human capabilities of the pilot and the manual ground controller. Detection, identification, tracking, intercept computations and weapons control must be highly automatic to effect an intercept "kill" within an extremely reduced reaction time. Communications and electronic equipments both air-borne and ground have become the key to successfully completing the mission. Solving the individual interceptor problem for a large number of simultaneous interceptions, using different types of aircraft and missile weapons, increases the dependence on the improved communication and electronic systems.

In SAC, global concepts, immediate reaction and centralized control of forces have further increased the complexity of modern war. The Commander-In-Chief of the Strategic Air Force must commit his force on a moment's notice to bring about maximum destruction of the enemy. His information on the status of his forces which are deployed world-wide cannot be more than minutes old. He requires a large quantity of information that must be gathered, automatically stored and timely presented to effectively utilize his forces. Therefore, reliable instantaneous communications on a global basis is vital.

Similar examples of the essential need for elaborate electronic systems include intercontinental ballistic missiles, ballistic missile defense, air traffic control, intelligence and reconnaissance, etc.

All of these examples require large, complex communication — electronic environments with multiple capabilities and extreme reliability.

Recognition Of the Problem

Communications and electronics, though lacking the glamour and appeal that aircraft and missiles enjoy, are essential to successful Air Force missions. In general, the growing need for advanced communication and electronic capabilities is being recognized.

To provide these communication-electronic capabilities, the problem involves research and development, system design and system engineering to obtain over-all mission objectives, development, development testing, production, production testing, implementation and operational testing. In other words, the operational requirement (operational concept) must be viewed throughout the development, production and the operational phases as a *system* to assure that the assembly and configuration of the multiplicity of equipment function technically to provide the desired operational needs. In fact, the future operational concepts will be determined not only by the weapon capabilities but to a great extent by the electronic system capabilities.

Although the research and development cycle of events starts with increasing the "state of the art," the real challenge to the Air Force is obtaining an operable system package time phased to meet the mission or function required. Due to the very nature of electronics, the equipments must work together to provide a given function. Further qualified personnel and adequate funds are required to provide these electronic capabilities. Some of our electronic industrial firms now recognize that electronically tieing together all of the capabilities required in an electronic system demands system design and engineering on a scale beyond anything the Air Force or industry has yet attempted.

The Air Force Solution

The Air Force solution to the problem or the research and development challenge, the systems concept, has been evolving over the past few years.

The system concept for weapons has been with us for some time, and, in the broadest sense, is a logical and natural consequence of technological progress. There have been variations in procedures of implementation, but the factors dictating the need for such a concept remain firm. The first of these factors stems from weapon system complexity; not only has the vehicle itself become much more complex, but there are many complex units in the form of equipments and sub-systems which must be time-phased into the final end-product. Thus, there is not only a need for management, but a centralized type of management in the form of a Weapon System Project Office (WSPO). The second factor is compatibility. Each element of the system must work in harmony with every other element. Compatibility among the various elements is not in itself sufficient, however. There must be an over-all pattern of engineering which integrates the various elements into an effective composite whole. This is what we commonly refer to as systems engineering.

More recently the electronic systems concept has evolved from an understanding of the reasons for a systems approach and what the systems concept can mean to advancing communications and electronic capabilities with a true perspective of the operational requirement.

To support our weapon systems we have had to build complex electronic ground environments, and the same considerations which have dictated the need for a weapon system concept are applicable to the development and implementation of these ground environments which we call electronic systems. These ground environments can be extremely large and complex. They must be compatible not only within themselves, but with other ground environments as well as the weapon systems they support.

While the principles which led to the establishment of WSPO's are the same as those which dictated the need for Electronic Systems Project Offices (ESPO's), in practice there have been some differences due to the fundamental nature of electronic systems and due to establishing the electronic systems concept several years after weapon systems. Illustrative of the broad character that an electronic system can take are System 431L, the Traffic Control and Landing System, and System 456L, the Air Force Global Communications System. Both of these systems are global in character; they involve extensive outlays of equipment, and have no silhouette as the B-52 has. The systems are not scrapped at one time, but are continuous in nature, being timely upgraded in capability to meet the changing requirements. In the case of the weapon system, the system engineering problems have been more confined and more readily identified. Further, the WSPO's at Wright Patterson Air Force Base are geographically concentrated and located with their principal center technical support and the principal AMC supporting element, the Directorate of Procurement and Production. Another advantage the WSPO has enjoyed over the ESPO relates to funding. Weapon systems have been funded on a package basis for some time, whereas the electronic systems are just beginning to obtain funding on a package basis. The pattern of our solution, the electronic system, however, has now been established. Systems such as the following have been initiated under the system concept: Strategic Air Command Control System; Distant Early Warning System; Intelligence Data Handling System; Traffic Control Approach and Landing System, and the Weather Data Handling System. Other systems such as the following are being initiated: Air Force Global Communications System, Communication and Electronic Intelligence Data Collecting

System, and the Airborne Early Warning and Control System. With package funding and a continued growth of our management capability, orderly progress toward meeting requirements will be possible.

Organizations to assure total system engineering of weapon systems and electronic systems are a result of research and development experience. In the past, weapon systems have been developed with very limited consideration of the ground supporting environment. System engineering has been focalized around the weapon system itself. This was not too serious as long as the ground environment remained primarily manual in character, but now the ground environment is becoming more and more automatic to the point that in effect electronic systems are automated to provide a dynamic loop for control, coordination and direction. This means that the systems engineering loop must be extended to coincide with the automatic control loop. Putting it another way, the weapon system must be integrated into the ground environment, and this process of integration should begin with design. Thus, the systems engineering tie between the weapon system and the ground environment must become closer. The ESPO will, in concert with the WSPO, close the existing gap. Although each WSPO will assist in closing this gap, the prime responsibility to follow through is with the ESPO because of the electronic character of the integration problem and because each ground environment supports a number of weapon systems, i.e., electronic system acts as the common denominator. Integration has another aspect which expands considerably the scope of our testing operations. Weapons and the electronic environment must be tested together, and these tests will present problems beyond the scope originally intended for the Systems Project Office. For these and other reasons, where the need dictated, organizations have been adapted to bring about systems engineering, test scheduling and integration on a mission basis. Our current example is the Air Defense Systems Integration Division which is a level above the WSPO's and is composed of ARDC, AMC and ADC personnel working together toward a common goal.

In summary, the vital need for communication and electronic support of Air Force missions has grown tremendously and is continuing to expand. The vastness and complexity of the electronic support is such that an orderly planned approach is required from the research and development efforts through the operational employment phases. This is achieved by the electronic system concept.

The Product Review Program and the Need for It

by William J. Laverick, U. S. Army Signal Equipment Support Agency

THE ARMY SIGNAL CORPS, IN COMMON WITH OTHER technical services, has, in the past, been forced by the pressure of events and the exigencies of the moment to send to the troops in the field equipments which were something less than we had hoped to supply—quality-wise, that is. The ultimate result of such pressure was foreseeable and in truth, materialized. The number of unsatisfactory equipment reports coming out of the Korean conflict demanded something other than action merely to correct those deficiencies as they occurred. It demanded that perhaps the whole concept of our cycle of development and production needed a re-examination. In other words, was our system of development, service tests, procurement and production sufficient to insure trouble free equipments or did it need some revisions? Now, rather than keep you in suspense until the last chapter, I will say emphatically that it most certainly did need revising. This need was recognized by the Chief Signal Officer and other top people in the Department of Defense and steps were taken in a timely manner to determine what these changes should be. The end results, among others, were the establishment of the troop user program, reliability studies on production contracts and the "product review."

For some time it has been becoming more and more evident to many of our top military and industrial leaders that the increasing cost and complexity of military equipments would, in the event of total war, put an unbearable strain on our economy—unbearable not only from the standpoint of dollars, but also in terms of available strategic and critical materials, and particularly in terms of availability of highly skilled and adequately trained labor. If, for instance, we were to specify that all our aluminum sheet metal fabrication must be done by heliarc welding, we would probably be in no serious trouble during peaceful times. But, with the outbreak of war we would be faced with a need to train more than ten times as many welders as were available. We could do it, of course, but it would take valuable time and effort and the quality of the work would not, at first, be of the highest order. However, if we were specifying, where possible, that our aluminum sheet metal work would be fabricated by riveting, we would still have people to train, but the training period would be shorter and the work quality higher.

So these then are the two major reasons for the start of the Signal Corps product review program: 1. The need to lower our field failure rate, and 2. The need to design for producibility.

Let me give you one short example of the type of field troubles we encounter no matter how comprehensive our laboratory and service tests have been. This particular type of failure is the direct result of underestimating the average American soldier. This tendency to underestimate the G.I. is almost universal with development engineers. One reason is because they, the development engineers, recognize a radio set, for instance, as a delicate instrument. Thus, they are prone to make such statements as "no one in his right mind would do thus and so" or "why worry about vibration damage; this is going into a fixed plant installation."

Certainly the threat of disciplinary action will not deter the G.I. if he decides to throw a delicate and expensive piece of equipment into a water-filled ditch. He is liable to reason that if the ditch is good enough for him, it is good enough for a radio set which he doesn't even own. Now I'm sure that most of us have seen, either in real life or the movies, the action that takes place when a truck full of soldiers pulls up at the side of the road so that the occupants may disembark and look for cover from enemy plane or ground fire. They come boiling out of that truck like kids getting out of school for the summer, and if they think of the radio equipment at all, it only receives sufficient attention to get it heaved over the side of the truck and into the nearest shell hole. Furthermore, as our methods of warfare change due to the advances of the atomic age, our G.I.'s will come up with some new and wonderful ideas for totally destroying unbreakable equipment. This same ingenuity is frequently used to convert equipment to uses for which it was not originally intended. And if you really want to get a field commander hot, just send him an answer to his failure complaint pointing out that he was misusing the equipment. An example of this occurred in Korea where we put into field use, for the first time, some light-weight, portable, twelve-line manually operated telephone switchboards. As with any new equipment, we expect to receive a certain amount of unsatisfactory equipment

reports. But we were certainly unprepared for the large volume of fan mail we *did* receive. This switchboard was designed for use in single units in front line areas and with an expected volume of traffic commensurate with that intended application. But our boys quickly found out that the switchboards could be operated in tandem and by piling up eight twelve-line units, they could have a fixed plant type of installation for rear area work with almost a hundred lines available. The continuous twenty-four hour traffic that flowed over these lines, together with certain inherent defects, caused frequent breakdowns and many complaints. The first reaction of the design engineers in a case like this, and of course the natural reaction, is almost invariably a counter complaint to the effect that the field forces were using the equipment in a manner never intended. But a realistic look at the situation will reveal that no matter what the original intention, the equipment will end up being used in whatever fashion the ingenuity of the most ingenious people in the world can devise to fit an unexpected situation, and we had darn well better design and redesign with that thought in mind.

I would like to pause here to explain that my remarks about the marvelous destructive powers of an ordinary run-of-the-mill G.I. are not meant as criticism of our soldiers, either as individuals or collectively. Our equipment should be designed, insofar as possible, so that inexperienced operators and maintenance personnel cannot damage it even under battle stress.

We are trying to do this in many ways and one of the tools for accomplishing this much-to-be-desired result is the "product review."

Late in 1953 the then assistant secretary of defense for applications engineering directed that an equipment was not to be considered ready for standardization and production until it had been established, by competent technical personnel, who were not directly responsible for the items development, that the principles of applications engineering were carefully considered during the development phase. The assistant secretary defined applications engineering as embodying thirteen criteria which would insure that expensive, non-essential or restrictive features would be eliminated; that the use of critical materials would be held to a minimum; that the design would involve no complexities which would limit production, nor require excessive tooling, nor increase training requirements, nor complicate maintenance and spare parts support.

The Signal Corps implemented this directive by establishing the Signal Corps product review committee with a joint membership of engineers from the U.S. Army Signal Engineering Laboratories, the U.S. Army Signal Supply Agency and the U.S. Army Signal Equipment Support Agency. The function of this committee is to approve or disapprove the findings and recommendations contained in a product review report prepared by the engineers in the applications engineering division of the U.S. Army Signal Equipment Support Agency.

We won't take the time here to go over each of the thirteen criteria of applications engineering. However, I would like to dwell on a few of them for a short time to give you some idea of the scope of this program.

Producibility: Due to the great technical advances in modern warfare, we have now reached a point where an all-out war will require so many pieces of complicated equipment, manufactured by skilled people, that we can expect to face a serious shortage of all skills. Welders, riveters, tool and die makers, machine set-up men, machinists, draftsmen, machine designers, and also competent office workers will be needed in larger volume than we will have available to us. We must, therefore, design our equipments in such a way as to eliminate skilled processes insofar as possible. In addition, we must eliminate any unskilled process wherever we can, merely for economy reasons. The cost of supplying a division of infantry with modern weapons, clothing, transportation and communications has now reached a frightening figure. So we must, of necessity, develop equipment which can be produced at a minimum cost, with a minimum of special tooling and using the least possible number of skilled production people.

Conservation of critical and strategic material: The design engineer will almost invariably call out the best possible material for a military application, from the standpoint of quality, with little regard for cost or availability. For instance, a spring must be made of beryllium copper or phosphor bronze. Nothing else will do. The fact that it will be flexed 50 times in 5 years makes no difference. Spring brass or spring steel is not the best there is, therefore it is not good enough for the Signal Corps. A long, careful look at the use of critical materials now can save us a lot of grief in the future.

Ease of maintenance: It is not unusual for an otherwise excellent design to turn out to be a nightmare to the maintenance people. In most cases, some of the blame must fall in the laps of the services. Nowadays a piece of communications gear is expected to be so simple that a 5-year-old can operate it. This can be done. But the end result is often a piece of gear that requires two Phi Beta Kappa Ph.D.'s to repair it. It is an established fact that the training of a competent radio operator is a quick and simple matter compared to the training of a competent radio repairman. We must, therefore, insist upon simplified equipment, easily maintained, even if it means that we have to teach our radio operators how to fire up a transmitter with more than two controls.

Use of standard reliable components: Everyone realizes the benefits to be derived from the use of standard components. The cost of placing a special resistor into a supply system stretching over a large part of the world is rather hard to calculate—but we know it is high. We recently reviewed a piece of equipment containing a standard, metal cased, paper, tubular capacitor which we have in our supply system by the tens of thousands. Except, instead of clamping this unit to the chassis with a standard clamp, our engineers had welded two threaded studs to the capacitor case. The studs were then placed through two holes in the chassis and held in place by lockwashers and nuts. When we suggested that the use of a standard capacitor would do the job, we were told that the special unit was stronger —of course, it was. It was stronger than necessary—which leads us directly into the next criterion.

Reliability: Good old reliability—she has had more crimes committed in her name than did Jesse James. Everyone has his own definition of reliability; one dictionary defines it as "trustworthiness." I like that one. It has a sort of solid, dependable sound to it. But in the recent months I have been leaning toward a negative definition which goes something like this: "Reliability is not a justification for building a skyscraper to do the job of a chicken coop." It is not at all unusual to find a clever, competent, and enthusiastic engineer adding 10 fragile components to a piece of equipment for the purpose of minimizing the danger of damage to an already rugged component. So we must be careful to evaluate our reliability efforts in conjunction with all other aspects of a good applications engineering program.

As you can see, such a program properly administered and aggressively pursued can return large dividends. But in addition to the direct and tangible benefits from the product review program, there are other results which might be termed ancillary benefits. Among these are increased awareness on the part of both Signal Corps and industry development engineers of the need for full time consciousness, during the development cycle, of the following principles: cost reduction, simplification, use of standard available components, reliability, maintainability, logistics considerations and producibility.

Large segments of the electronics industry are already applying these principles of applications engineering to their commercial products and to some military development programs. We hope that sometime in the not too distant future the need for product reviews will gradually disappear as the thought processes used in this program become second nature to everyone concerned with developing new items. And then those people now engaged in that work can go back to poker playing for excitement.

MAGNELINE

NEW DIGITAL READOUT INDICATOR

DURABLE . . . COMPACT

. . . EASY TO READ

MAGNELINE is the ideal indicator for use in computers and electronic systems requiring accurate display. It positions rapidly — produces two-per-second responses with low power.

Simplicity assures long life. Only one integral part is in motion. Featherweight rotor is magnetically activated, rides on precision ball bearing. No mechanical detents or electrical contacts to wear or foul. The 5/8" x 3/8" digits are white on black background to give clear legibility at 25 feet. Even at 60° angle, figures can be quickly and accurately read.

Magneline measures only 23/32" wide by 2 29/64" in diameter. Weighs only 3.3 ounces. Units can be stacked in series for multiple digits. Write for complete technical data.

PATWIN
WATERBURY 20, CONNECTICUT
A Division of The Patent Button Company

Powell

(Continued from Page 24)

the summer, or the autumn, or the fall—whether he would like to start it in the arctic or the tropics, or the Near East. He can also decide whether he would rather start it with conventional weapons or non-conventional weapons. These are his decisions. You have nothing whatever to say about it.

If you fail to plan for any particular contingency, all you are doing is inviting a potential enemy to pick that one. Your very unpreparedness invites war! Your preparedness must be as flexible as the choices a potential enemy can make. If he considers starting it here at this time and this place and he finds that you are prepared for that, he then considers starting it at another time and another place. If he finds that you are prepared for that and he keeps on thinking up times and places, if he finds that you are prepared for all of them, he is likely to end up being a peace loving nation. I have never heard of anyone picking a fight with a man he thought he couldn't beat.

Mark Twain left home when he was about 18 because he couldn't get along with his father. He came back when he was 24. He said that he never got over how much his old man had learned in 6 years. Now, most of us have felt a little bit like that. Most of us at one time thought our dad was behind the times. But gentlemen, if your dad were 20 or 30 or 40 years behind the times it didn't matter very much because the times weren't moving much in those days.

Time Lag

Now, in these times things are exploding! If you are 20 or 30 months behind the times, you are further behind than your dad was when he was 20 or 30 years behind.

The problem is that you and I were born, educated and lived during the age of plodding progress. We are almost incapable of realizing that progress is now made on purpose by inspiration rather than made by accident with perspiration.

It took man 250 years to go from a short bow and arrow to the long bow and arrow — two hundred and fifty years of painful plodding technological progress. It didn't take 10 years to go from an A-Bomb to an H-Bomb.

Now is the race for brain power. Push ahead and you rule the world. Fail to maintain the pace and you, too, can be a second-class nation.

How many scientists and engineers can you produce? At the maximum maybe the number who have the necessary aptitude may be one out of a hundred!

What are you going to do with the other 99 kids? Deprive them of their right to an education, just because they have other than technical aptitudes? Of course not! Neither can you make second class engineers out of them. If you do you will have a lot of vast engineering projects run by some partially vast engineers!

Brainpower has replaced manpower as a national resource. This fact dictates that you need to educate everyone according to his aptitude. We need better brains across the board in all fields of human endeavor.

To concentrate only on scientists and engineers would be like driving an automobile and concentrating on making one wheel go faster than the other wheels.

Let us restore the prestige of brains, engineering brains, management brains, all kinds of brains. While we are at it, let us restore respect and provide recognition for those who have ability to get things done!

"Technological Adams"

Democracy should not be construed as a synonym for mediocrity. The nation that fails to produce brains fails to produce leaders!

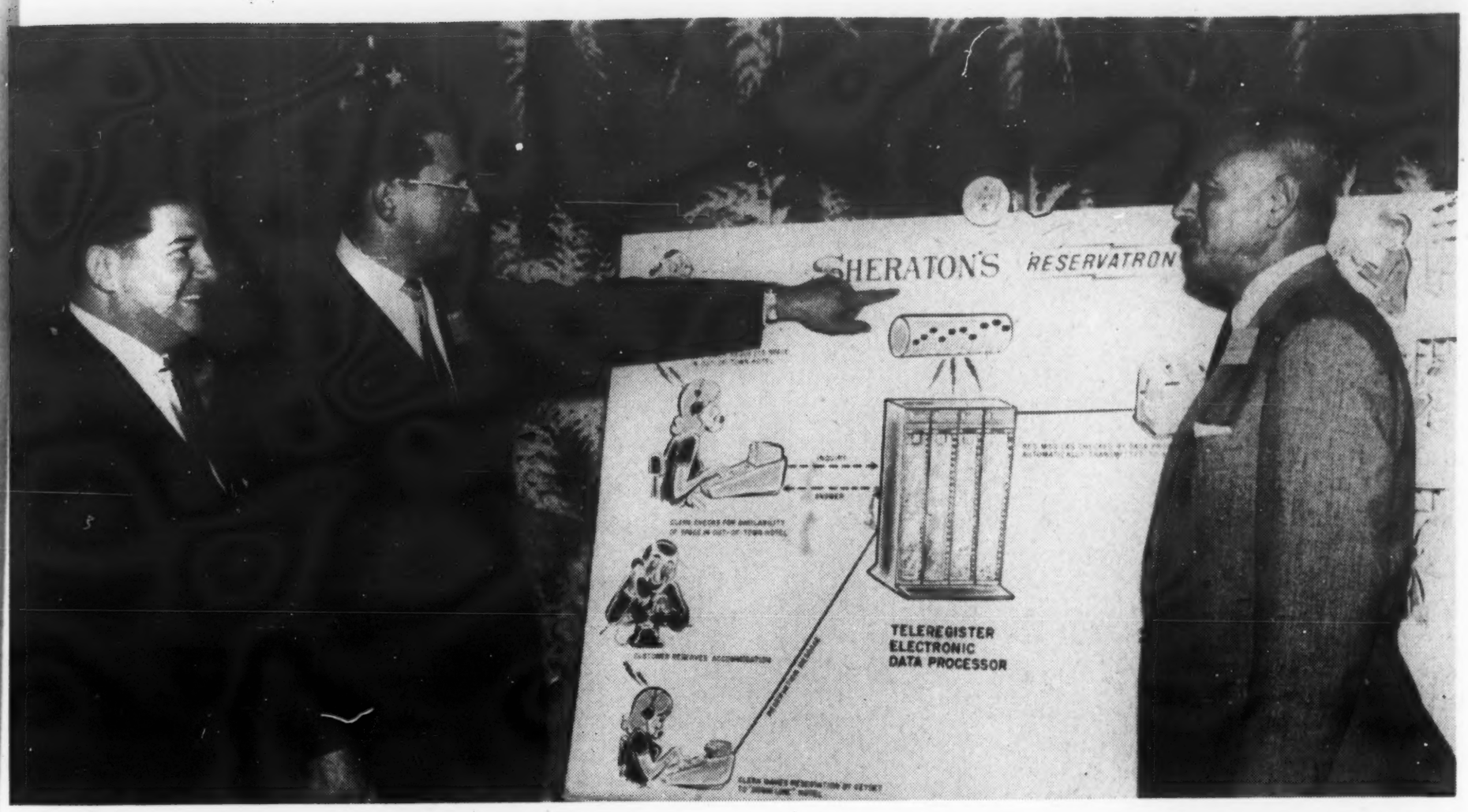
History played a trick on you! It made you a kind of "Adam," a technological Adam. You are the only generation in the 50,000 years of mankind's history that turned a corner, and this was in 1945.

Everyone previous to you was born, lived and died in one age. A man who was born in the stone age died in the stone age. The stone age merged very gently into the wood age. People born in the iron age died in that iron age. But, gentlemen, in your lifetime you have spanned ages. From automobiles to airplanes, to jets, to electronics, to nuclear science.

This makes you unique. You are a kind of technological Adam, standing on the threshold of a new world of millions of discoveries. There is no limit to your future.

You are the last generation on earth who will be able to look back along the slow curve of progress with the wisdom of experience, and at the same time look ahead with the vigor of youth to a new world on the upswing.

Onrushing technology has placed you in the driver's seat.



Michael T. McGarry, General Manager of the Sheraton-Carlton Hotel, Washington, D. C., and Foster H. Gurney, General Manager of the Sheraton-Park Hotel, Washington, explain the new "Reservatron" System to Colonel W. J. Baird, Editor of SIGNAL.

"RESERVATRON," THE FIRST AND ONLY ELECTRONIC reservation service in the entire hotel industry was recently unveiled by the Sheraton Corporation for the Sheraton-Park and Sheraton-Carlton, Washington, D. C.

The electronic data processor enables the well-trained hotel personnel to determine the availability of rooms in 28 of the Sheraton Hotels and give information of same in 4 seconds.

If a resident of Washington wishes to make a reservation at the Sheraton Palace in San Francisco, he calls one of the Sheraton Hotels in Washington and makes his request known to the Reservation Clerk. The clerk has only to insert a special plate into a "keyset," a small device resembling an adding machine, which specifies the type of accommodation (studio, double, twin, suite) arrival date, number of nights and time of arrival; she then flips the switch on the keyset and receives the required information from the memory drum in less time than it takes to dial a telephone.

A Sheraton reservations clerk inserts a plate in the Agent Set connected into an Electronic Data Processor.

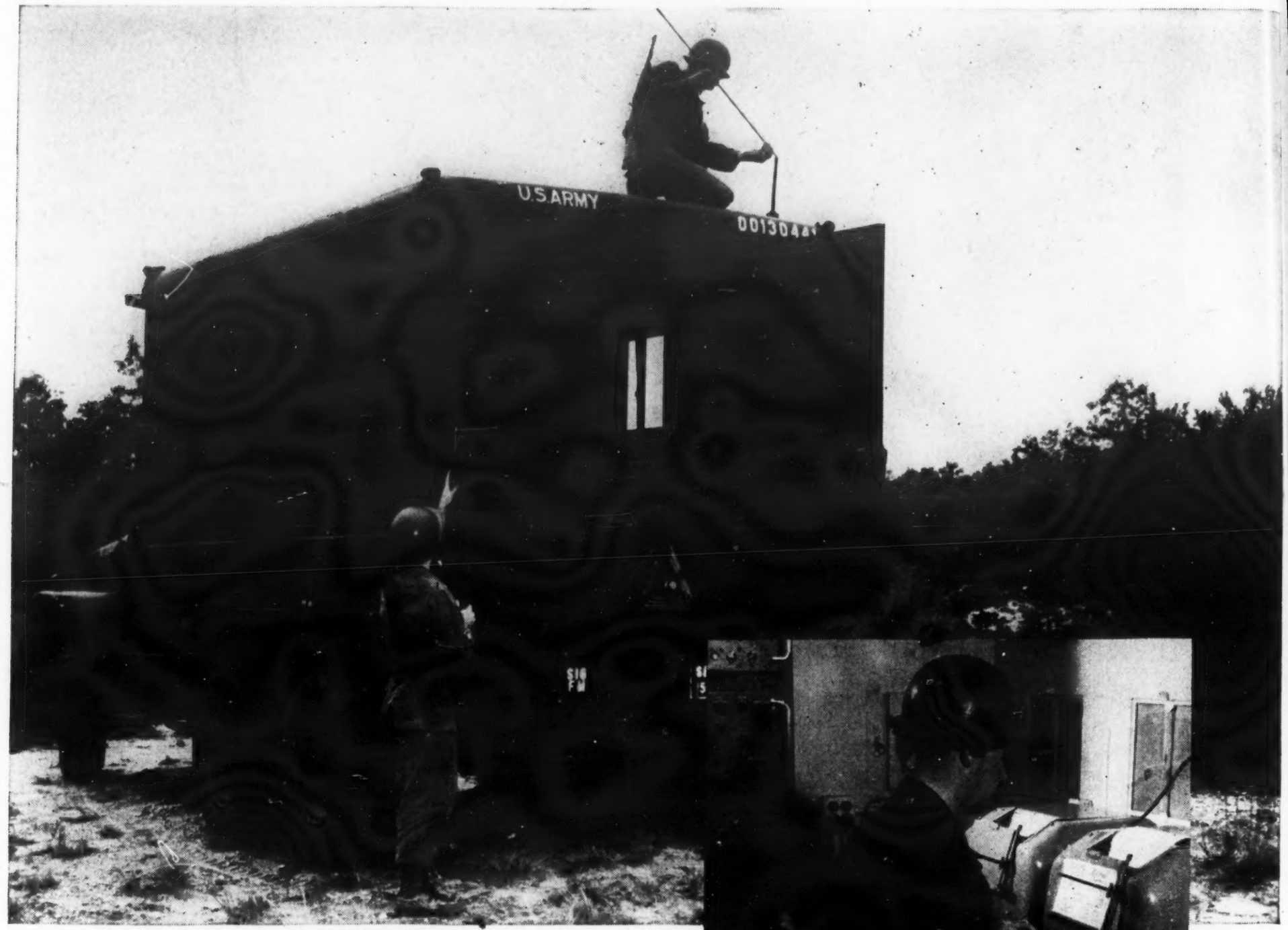
"RESERVATRON" UNVEILED IN WASHINGTON SHERATON HOTELS

The heart of Reservatron is an electronic data processor used by Teleregister at its Service Bureau in New York. It retains up to the minute information on every guest room in the 28 Sheraton Hotels. At this time the processor and communication channels are used to render service only to Sheraton Hotels located throughout this country and Canada.

About Teleregister

The Teleregister Corporation, one of the leaders in the field of automatic data processing, has been serving the brokerage industry since 1929. It provides automatic display of prices of stocks on various exchanges in more than 500 brokerage offices in about 70 cities from coast to coast.

It has in recent years built and installed systems for six major airlines and an inventory control system for the Hood Rubber Division of the B. F. Goodrich Company. Teleregister will deliver six major airline systems this year as well as a railroad reservations system for the New Haven, the New York Central and the Santa Fe Railroads. The company is also building three savings account systems.



When the U. S. Army moves up Kleinschmidt is in the van

Kleinschmidt page printers and reperforator teletypewriters receive and transmit teleprinted communications wherever a truck can roll.

As division headquarters advances in the field, it is imperative that communications with outlying units be maintained without interruption. Kleinschmidt teletypewriters and related equipment, installed in a U. S. Army cargo truck and transmitting by radio, provide a message center that meets every demand of mobility and dependable two-way communications. These Kleinschmidt units, developed in cooperation with the U. S. Army Signal Corps, furnish sender and recipient with an identical teleprinted original, eliminating misinterpretation and speeding the required action.

Research and development of equipment for transmitting and receiving printed communications has been a continuing project at Kleinschmidt for almost 60 years. This unparalleled store of experience, now joined with that of Smith-Corona Inc, holds promise of immeasurable new advances in electronic communications.

KLEINSCHMIDT LABORATORIES, INC.

PIONEER IN TELEPRINTED COMMUNICATIONS EQUIPMENT

A SUBSIDIARY OF SMITH-CORONA INC • DEERFIELD, ILLINOIS

Lerner (*Continued from page* 46)

The complete briefing is recorded on magnetic tape so that it can be stored in the automatic message exchange and be played back for the division commander and his staff when they arrive. Both headquarters keep copies of this recording so that it can be frequently reviewed as the operation progresses.

At Task Force Headquarters the personnel officer passes a message to the automatic message exchange on the new mail address of all members of the air-borne division. When circuits are free, this message is sent to the Postmaster, New York City, former station of the division, the Adjutant General, Washington, and others.

The Civil Affairs military government officer dials his control subset to call the local minister of labor to arrange for additional labor forces. The local automatic circuit exchange uses the conversion feature of the system and immediately places this call on the local commercial communications system.

By this time the division has jumped off on its attack. The division commander finds it necessary to request authorization for employment of advanced weapons. This request is quickly dialed through Task Force Headquarters and Theater Headquarters to the Joint Chiefs of Staff. Very rapidly the reply is sent back through these same channels and the division proceeds with its mission.

The task force intelligence officer now dials a query to the automatic data service center through the control subset, for the latest information as reported by the division. This intelligence information is typed out on his teleprinter and through a data display tube he is given a picture of enemy forces in the vicinity of the division.

Well, this is how I would use the system. I can go on with hundreds of additional illustrations on the employment of the system each different from the others, but let me summarize what we have covered.

We have taken a very brief look at our existing communications systems. In general, they provide us with limited facilities, as for example, the lack of a completely integrated global voice network on a secure basis. Because of their quasi-commercial construction, they are vulnerable. We have several specialized systems lacking the integration required for effective management. Finally, they provide insufficient response to the command control, logistics and administration. We have briefly covered the limited improvements to be expected from systems now covered in our mid-range planning effort. Here we are attempting to increase the quantity of communication facilities and the types of services available, on an integrated basis. We are attempting to reduce the vulnerability of our installations and systems and increase mobility, both strategic and local. We are attempting to improve our management capability. More important, we are attempting to achieve improved response to the commander's requirements.

On a long-range planning basis, we will attempt achievements even greater than those covered in our mid-range planning. Here again, we are striving to make increased services and facilities available to the communication customer. These facilities must be provided on a completely integrated basis. They must provide the requisite flexibility, reliability, security and mobility to survive in modern warfare. In the process of planning these facilities, we have recognized that the communication complex must respond to the commander's requirements and preserve the integrity of his command.

Lt. Gen. James D. O'Connell, USA, Chief Signal Officer (right) was presented his third star and flag by Lt. Gen. Carter B. Magruder, USA, Deputy Chief of Staff for Logistics (left) at the Pentagon on July 11, 1958.

THIRD STAR FOR GENERAL O'CONNELL

First 3-Star CSigO

The entire membership of AFCEA wishes to congratulate Lieutenant General James D. O'Connell on becoming the U. S. Army's first Chief Signal Officer to be elevated to the three star rank. This promotion is one which was well-earned for distinguished, outstanding and devoted service to his Country for a period of over 35 years. General O'Connell, the 1st Vice President and an honorary life member of AFCEA, has been a staunch supporter of the Association and major contributor to SIGNAL Magazine.

General O'Connell was named Chief Signal Officer by President Eisenhower in March, 1955, after serving four years as Deputy Chief Signal Officer. He was graduated from the U. S. Military Academy in 1922, and his first assignments were in the Infantry, transferring to the Signal Corps in the late 1920's.

13th

AFCEA CONVENTION

June 3, 4, 5, 1959

Wednesday Thursday Friday

SHERATON-PARK HOTEL

Washington, D. C.

Be sure to enter these dates on your calendar

NOW

AFCEA Group Members

Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Acme-Danneman Co., Inc.
Admiral Corp.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Arnold Engineering Co.
Atlas Film Corp.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Autonetics, Division of North American Aviation, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
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California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
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Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Close Associates, Inc.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Contraves Italiana
Convair, Division of General Dynamics Corp.
Cook Electric Co.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
A. C. Cossor Ltd.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
DuKane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telecommunication Laboratories—West Coast Branch
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Hallamore Electronics Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co., The
Haloid Co.
Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
Hopkins Engineering Co.
Hughes Aircraft Co.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
International Business Machines
International Resistance Co.
International Telephone & Telegraph Corp.
Jacobsen Manufacturing Co.
Jansky & Bailey, Inc.
Jerrold Electronics Corp.
Kellogg Switchboard & Supply Co.
Kleinschmidt Laboratories, Inc.
Koiled Kords, Inc.
Leich Sales Corp.
Lenkurt Electric Co.
Lewyt Manufacturing Corp.
Lockheed Aircraft Service, Inc.
Machlett Laboratories, Inc.
Magnavox Co.
Marconi's Wireless Telegraph Co. Ltd.
Materiel Telephonique Co.
Michigan Bell Telephone Co.
Montgomery Co., The
Motorola, Inc.
Mountain States Telephone & Telegraph Co.
Mullard Ltd.
Muter Co.
Mycalex Corporation of America
National Co., Inc.
Nelson Technical Enterprises
Nems-Clarke, Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
New York Telephone Co.
North Electric Co.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Co.
Otis Elevator Co., Electronic Division
Pacific Mercury Television Mfg. Corp.
Pacific Telephone & Telegraph Co.
Packard-Bell Co.
Page Communications Engineers, Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co., Ltd.
Prodelin Inc.
Radio Corporation of America
Radio Corporation of America. Defense Electronic Products
RCA Great Britain, Ltd.
Radio Engineering Laboratories, Inc.
Ramo-Wooldridge Corp.
Raytheon Manufacturing Co.
Red Bank Division, Bendix Aviation Corp.
Reeves Instrument Corp.
Rocke International Corp.
Saxonburg Ceramics
Society of Motion Picture & Television Engineers
Sonotone Corp.
SoundScriber Corp.
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co.
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Telephone & Cables, Ltd.
Stanford Research Institute
Stewart-Warner Corp.
Stoddart Aircraft Radio Co.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Surprenant Mfg. Co.
Sylvania Electric Products, Inc.
Technical Materiel Corp., The
Tele-Dynamics, Inc.
Telephonics Corp.
Teletype Corp.
Tensolite Insulated Wire Co., Inc.
Texas Instruments, Inc.
Times Facsimile Corp.
T.M.C. (Canada) Ltd.
Transitron Electronic Corp.
Trans-Sonics, Inc.
Triad Transformer Corp.
Tung-Sol Electric, Inc.
Union Carbide Corp.
United Shoe Machinery Corp.
United Telephone Co.
United Transformer Co.
Van Norman Industries, Inc., Electronics Division
Waterman Products Co., Inc.
Webster-Chicago Corp., Government Division
West Coast Telephone Co.
Western Electric Co., Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Wheelock Signals, Inc.
Wickes Engineering & Construction Co
Wilcox Electric Co., Inc.
Willard Storage Battery Div., Electric Storage Battery Co.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

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Chapter News

Augusta—Fort Gordon—Presentation of the chapter's first annual award to a high school graduate. Left to right: Lt. Col. Darce R. Knight, ASTC, chairman of the awards committee; Frank Clark of Augusta's Richmond Academy, the winner; and Chapter President James M. Williams, Southern Bell T&T Co.

Arizona

"Navigation Aids" was the subject of the May 13th meeting. L. D. (Dave) Callahan, Vice President of Gilfillan Brothers, Inc., Los Angeles, was the guest speaker.

Held at the USAEPG Officers Open Mess at Fort Huachuca, the meeting was preceded by a Western barbecue.

Augusta-Fort Gordon

Frank C. Clark, a June graduate of Richmond Academy in Augusta, received the first Award of Distinction to be presented by the Augusta-Fort Gordon Chapter.

This chapter award is given "as recognition of an intense interest in the field of communications and electronics and a desire to continue formal college training, as well as a high over-all academic average, integrity of character and leadership potential." The prize will be presented annually to a graduating senior from one of Augusta's three high schools.

The recipient, son of Mr. and Mrs. J. F. Clark, 1225 Holden Dr., Augusta, will receive $100 from the chapter for first-year college tuition fees. He plans to major in electrical engineering at the University of Georgia.

Presenting the award to Mr. Clark at the Academy's Honors Day ceremony on June 2nd, were Chapter President James M. Williams, suburban manager of Southern Bell Telephone Co., and Lt. Col. Darce R. Knight of the Army's Signal Training Center, awards committee chairman.

Baltimore

On June 21st, members, their families and friends attended a luncheon meeting at the United States Naval Academy. After luncheon at the Officers Mess, there was a tour of the United States Naval Radio Station or a cruise on a Yard Patrol boat.

Program arrangements were made by Cdr. John Greksouk, officer in charge of the Naval Radio Station and a vice president of the chapter.

The following officers were elected for the coming year: President—Trevor H. Clark, Westinghouse Elec. Corp.; vice presidents—Buford M. Brown, Westinghouse Elec. Corp.; Charles L. Cogswell, Thompson Trailer Corp.; G. Arleigh Dom, The Martin Co.; Cdr. John Greksouk, U.S. Naval Radio Station; Charles W. Hass; Joel Jacobson, Aircraft Armaments, Inc.; Cdr. Bob Kirsten, U.S. Coast Guard; Col. Timothy McKenzie, Signal Officer Second Army; E. Charles Meyenburg, Bendix Radio Div., and Vernon Houck, Bendix-Friez Division; secretary—Ray Moore, Hoover Electronics; treasurer—Thomas E. Thompson, The Martin Company; council members—W. Roger Dickinson, Railroad Perishable Inspection Agency; Richard M. Henry, Westinghouse Elec. Corp., and John M. Pearce, Hoover Electronics.

Chicago

The Allied Radio Corporation was host to the chapter at a recent meeting held at its plant in Chicago. Guest speaker was Walter C. Lipinski of the Argonne National Laboratory, Lemont, Illinois. His subject was "Electronic Control of Nuclear Reactors."

Mr. Lipinski discussed in detail the instrument systems used on the new experimental boiling water reactor power plant at the Argonne National Laboratory. His talk was a presentation of a diagrammed article on this topic, which he and Robert L. Ramp of the Laboratory staff had written and which had appeared in the February 1957 issue of the ISA Journal (Instrument Society of America).

The chapter met at the new Officers Club, Fort Sheridan, on May 22nd. Co-hosts for the meeting were Fifth U. S. Army Headquarters Signal Section and the U. S. Army Signal Agency of Chicago.

Dinner was followed by an address by Brigadier General Stuart S. Hoff, Chief of Combat Development and Operations Division, Office of the Chief Signal Officer, Washington, D. C. General Hoff's topic was "Communication Requirements for the Army of the Future." He explained what is needed for good communications in the constantly changing techniques of land warfare.

Decatur

The following report on the chapter's electronics course, submitted by Lt. Col. Nicholas S. Munson, chapter president, speaks for itself:

"In the fall of 1953, the Decatur Chapter, meeting at the Decatur Signal Depot, opened a service new to its members and perhaps still unique among AFCEA chapters. It began enrollment of students in courses taught by chapter members in the fields of electricity, radio and television.

Decatur—The chapter's night school of electronics has a current enrollment of 120. Shown above are, left to right, Richard Binns, J. J. Farneris and Marvin R. Bueckler, students in the radio course. The other courses of instruction are electricity and television.

"The first class ran for two years. A second, which began a year later, was also a two-year course. It will be completed this fall. The third course, started last fall, will run for a shorter period because experience revealed that our students, many from such local firms as Illinois Bell Telephone, Western Electric, Borg Warner, Illinois Power Company, Caterpillar Tractor Company and the Decatur Signal Depot, require far less training in the fundamentals of electricity than was offered in the first two courses.

"Our local AFCEA school has already graduated some 125 students in fundamentals of electricity and radio. In a few brief years, the courses have achieved such a reputation that at the last enrollment many applicants had to be turned away. There are now 40 students who will graduate in October and 80 new students scheduled to finish in April of next year.

"After an initial 12 weeks in which to determine whether or not they wish to complete the course, students must join AFCEA or drop out of the school. Textbooks and study materials, supplied by AFCEA, cost each student about $5.50 for the entire course. As part of the laboratory work in radio, each student purchases parts for and builds a five-tube standard broadcast band receiver at a cost of about $8.50. Classes are in session three hours in the evening, Monday through Friday, with each class group meeting one night a week. Tuition cost to the student is 50 cents per class payable in advance, each 12 weeks. The instructor receives $3 an hour.

"At present, the school principal and only instructor is Henry E. Malone, who teaches all three courses, five nights a week, in addition to his 40-hour week as a member of the maintenance division management staff, Decatur Signal Depot. Whether Henry is imbued by the Signal Corps' aim to get the message through or merely conscious of his pedagogic responsibilities, he is appreciated for his do-it-yourself teaching methods.

"One evening, sorely pressed for time to produce—or reproduce—examination papers for the next evening's class, Henry found himself working at home and out of gelatin for the duplicator used in preparing worksheets and other papers for the course. A quick foraging expedition through the kitchen produced five boxes of lime gelatin dessert. Sugar and all, our hero stirred up a batch large enough to run off 50 fragrant examination papers. He then spent the next two evenings composing a voucher plausible enough to allay an auditor's suspicions about lime jello as an academic prop.

"Why do our students enroll? Many to lay the basis for pursuit of amateur radio as a full-fledged hobby. Others, such as Bob Matteson, simply to learn something authoritative about a subject in which they are interested. A PBX installer for the telephone company and vice president of the chapter, Bob is about to wind up a year and a half of studying radio. He believes radio is continually more closely related to the telephone business, and besides, he simply likes radio. He first learned of the AFCEA course through the telephone company, and after missing only two classes in his year and a half he feels he knows his way around inside a radio so well that he could climb down the antenna and crawl out through the speaker.

"Whatever the individual motive or gain, we believe the industries or individual groups from which our students come reflect the benefits they have gained in their studies. And in the broad view, our Civil Defense communications network will undoubtedly share in the benefits."

London—Commercial television in Great Britain was the subject of the chapter's April meeting. Pictured above are a group of members during the conducted tour of the Wembley Television Studios of Associated Rediffusion Ltd.

Gulf Coast

Program feature of the June 17th meeting was a film, "The DEW Line Story," which was presented by the local office of the Southern Bell Telephone and Telegraph Company.

The meeting was preceded by dinner at Gus Stevens Restaurant.

Kansas City

The chapter's June 12th meeting was held at Richards-Gebaur Air Force Base with some 150 members and guests in attendance.

The Air Force program was presented by Capt. Katchel, who gave a talk on "SAGE Operations" and showed a film entitled "SAGE." He then conducted the AFCEA group on a tour of the SAGE Building, with representatives of IBM and the Air Force serving as guides.

During the business session, new officers were elected for the coming year as follows: President—Lt. Col. L. E. Eastmond, USAR, American Tel. & Tel. Co.; vice presidents—Col. L. C. Heartz, USAF, Central Air Defense; S. V. Lyons, United Telephone Co.; R. R. Van Zant, Wilcox Electric Co.; secretary-treasurer—Col. R. R. Mallory, USAR, American Tel. & Tel. Co.; directors—Lt. Col. Z. W. Barnes, USAF, Central Air Defense Force; Lt. Col. G. D. Meserve, USAF (Ret.), Telecom, Inc., retiring president; J. V. Wilcox, Wilcox Electric Co., Inc.; J. T. Wallingford, Central Tech. Inst.; W. G. Rider, Rider-Philpott Studio, K. B. Karns, Civil Aeronautics Admin.; Col. L. J. Staub, USA, Army Air Defense Command; W. E. Goll, Manufacturers Representative, and W. E. Fisher, Southwestern Bell Tel. Co.

Lexington

Officers and executive committee members met with Executive Vice President W. B. Goulett on May 26th for a general discussion of AFCEA business.

Those present were: Chapter President Charles L. Morrison, General Telephone Co.; Col. Kenneth Gonseth, commander and Lt. Col. Henry L. Morris, assistant commander, Lexington Signal Depot; Maj. K. J. Holmes, chief of station liaison, Lexington Signal Depot, past chapter president, and Harold W. Madden, Lexington Signal Depot, chapter secretary.

London

A two-hour tour behind the scenes of commercial television in Great Britain was enjoyed by some 60 members of the chapter and their guests. The occasion was a visit, on April 17th, to the Wembley Television Studios of Associated Rediffusion Ltd., Wembley, Middlesex.

Those attending were divided into small groups and escorted by engineering personnel who covered not only the technical aspects of the TV electronic equipment but also answered questions on programming, lighting and TV camera techniques.

The group gathered afterwards at the Century Hotel, Wembley, for dinner and listened to Derek Law, the Senior Engineer at Wembley Studios, who gave an interesting talk on the "History of Commercial Television in Great Britain."

Louisiana

Principal speaker at the May 15th meeting was A. Frank Fairley, New Orleans Postmaster, who presented a program entitled "Your Post Office, Its Problems—Present and Future." Mr. Fairley stated that the mail service, es-

Louisiana—Reading from left to right are the new officers elected at the May meeting: Dr. Joseph C. Morris, Tulane Univ., 2nd vice pres.; William A. Gillentine, Southern Bell T&T, president; Wes Massey, New Orleans Public Service, Inc., 1st vice pres.; and Bruce Hay, Southern Bell, secretary. Not present: Joseph D. Bloom, WWL-TV, treasurer.

pecially air mail, is one of the most important of all media of communication. His opening statement was that the Post Office Department is the world's largest communication system.

Dr. Joseph C. Morris, Executive Vice-President of Tulane University and a vice president of the Louisiana Chapter, presided at the meeting.

The following new officers were elected: President—W. A. Gillentine, Jr., Southern Bell Tel. & Tel. Co.; first vice president—Wes Massey, New Orleans Public Service, Inc.; second vice president—Dr. Joseph C. Morris, Tulane University; treasurer—J. D. Bloom, WWL-TV; secretary — A. B. Hay, Southern Bell Tel. & Tel. Co.

Held at the Officers Club at the new Naval Air Station at Belle Chasse, the meeting was preceded by a social hour and dinner.

New York

At the May 28th meeting, W. W. Watts, Executive Vice President of RCA, discussed the current status of development, manufacture and utilization of the transistor in both military and industrial applications.

In discussing "The Transistor—Mighty Mite and Tiny Giant," Mr. Watts stated that industry's present aims for commercial semiconductors are: frequency—1,000 megacycle region; temperature—about 400 degrees C: power at low frequency—200 watts plus.

Mr. Watts concluded his talk with a demonstration of the progress in miniaturization through advance in the state of the electronic components art. Included was a microminiaturized version of the TCC-26 multiplex having a weight of 3 lbs., power consumption of 3 watts and a component density of 650,000 components per cubic foot. Compared to the TCC-13 Korean War model, weighing 1200 pounds, requiring 1100 watts and with a component density of 250 components per cubic foot, the microminiaturized version was a dramatic proof of the progress we are witnessing today.

Seated at the head table were: Chapter President L. R. Engler; National President F. R. Furth; Mr. Watts, Director and Past President of AFCEA; National Directors Joseph E. Heinrich and George W. Bailey; Col. William E. Jennings, Signal Officer, First Army; Thomas P. Wynkoop, president, RCA Radiomarine Corp. of America; C. L. Wickstrom of Pacific Telephone and Telegraph Co., past president of AFCEA's San Francisco Chapter, and Carl E. Scholz, vice president, American Cable and Radio Corp.

A little rain did not dampen the spirits of the annual Garden Party and Ladies' Night held June 18th at the Officers Club on Governors Island. Through the cooperation of Col. W. E. Jennings, Signal Officer, First Army, members, wives and guests enjoyed a delightful buffet supper followed by an evening of dancing. Honored guests were Major General and Mrs. George L. Van Deusen.

North Carolina

Maj. Gen. James Dreyfus, Chief of the Procurement and Distribution Division, Office of the Chief Signal Officer, United States Army, addressed the chapter's May 22nd dinner-meeting. His topic was "Supply Management."

Special guests of the chapter were Major General Robert F. Sink, Commanding General, XVIII Airborne Corps, Fort Bragg, and Mrs. Sink.

Held in the main ballroom of the Fort Bragg Officers Open Mess, the meeting was attended by 112 members and guests. Among those present were H. Dail Holderness, president of Carolina Telephone and Telegraph Company, and J. C. Baughman, General Military Coordinator, Southern Bell Telephone and Telegraph Company, Atlanta, Ga.

Orange

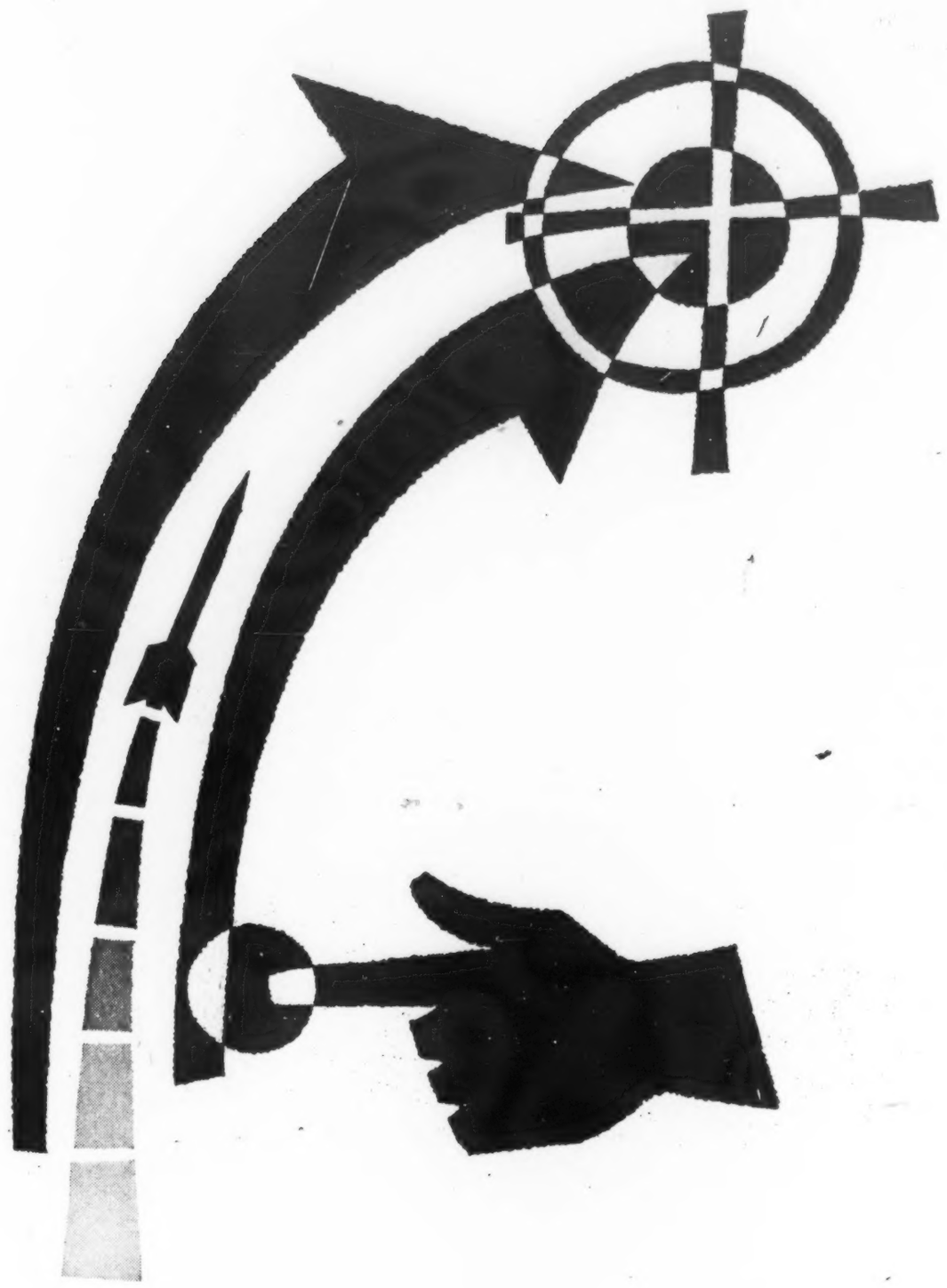
New officers for 1958-59, elected on April 17th, are headed by Lewis A. Brown of Southern Bell Telephone and Telegraph Company as president. Others are: First vice president—Maj. Morris R. Muse, USAF, Air Rescue Service; second vice president—Lt. Col. Donald E. Dobbins, USAF, Ret., RCA; third vice president—Vincent Meder, Radiation, Inc.; fourth vice president—Charles W. Benfield, U. S. Navy Underwater Sound Reference Laboratory; secretary—Donald E. Murphy, Southern Bell Tel. & Tel. Co.; treasurer—H. Ray Weaver, Minute Maid Corp.

Lt. Col. Earl E. Frink, USAF, commander of the 1365th Photo Group, Orlando, presented a program on "The Role of Military Photography" at the March meeting at the Elks Lodge.

Assisted by Sgt. William G. Kennedy, who coordinated sound film clips, Col. Frink reviewed the history of the Air Force Photographic and Charting Service from its inception in the Korean War to its present day mission of processing and distributing film for the Air Force. Activities of the Photographic and Charting Service include: Air Force News Review, film training aids, staff film reports, engineering and training films, special film projects, film bulletins and miscellaneous clips.

The April meeting, held in the conference room of Southern Bell, was addressed by R. J. Bobber, Assistant Head of Research and Development, U. S. Navy Underwater Sound Reference Laboratory, Orlando.

New York—Pictured during the chapter's annual social gathering at the Officers' Club, Governors Island, are, left to right: Col. William E. Jennings, Signal Officer, First Army, and host for the evening; Mrs. Glenn D. Montgomery; Miss A. Mikkelsen; Mrs. Jennings; and Glenn D. Montgomery of AT&T Long Lines, new AFCEA Regional Vice President.



TELLING THE MISSILE WHERE TO GO

. . . and how to get there!

The button is pushed. The missile rises from the launching pad – slowly – then roars into space.

But the problem has just begun! Now the "brain" inside the missile takes over. This is the crucial part of missile warfare.

The target must be found – or met head-on – or overtaken. The missile must be *steered*. It must change course, double back if necessary. It must "think" its way to the enemy.

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ITT is especially qualified for missile guidance development–because of long experience and special skills in air navigation and radar.

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***North Carolina**—Maj. Gen. James Dreyfus, Chief of P&D Div., OCSigO (far left), addressed the May 22nd meeting at Fort Bragg. Others shown (left to right) are Maj. Gen. Robert F. Sink, Commander, XVIII Airborne Corps and Fort Bragg; H. Dail Holderness, president of Carolina Telephone and Telegraph Co., and Chapter President James R. Fowler, secretary and treasurer of Carolina Telephone and Telegraph Co.*

***Scott—St.Louis**—Col. Wilbur W. Bailey, Chief of the Communications System Div., Directorate of Communications-Electronics, USAF, speaking before the chapter's June meeting.*

Describing, with the aid of slides, the many phases of research and development at the Laboratory, Mr. Robber told of its $750,000 worth of electronic equipment which is used in calibrating and measuring to within three-tenths of one cycle per second. Measurements are also made for universities, contractors and NATO countries. In addition to making measurements on three piers and a floating barge in Lake Gem Mary, the Laboratory conducts experiments in large indoor tanks—one is echo proof and another can be pressurized to simulate conditions of 2000 feet below sea level.

Pittsburgh

The chapter held its eleventh annual banquet at the Holiday House on June 19th. Present for the occasion was W. B. Goulett, AFCEA Executive Vice President.

The following new officers were installed for the coming year: President —R. C. Ridley, Copperweld Steel Co.; vice presidents—E. M. Kliment, Western Union Tel. Co.; H. D. Choate, Bell Tel. Co.; John G. Pabst, Saxonburg Ceramics; H. S. Brown, Mine Safety Appliance Co.; J. I. Seitz, Union Switch & Signal Co.; J. M. Lavine, Joseph Horne Co.; Signal ROTC Unit Advisor, Carnegie Inst. of Technology; secretary—H. W. Shepard, Jr., Stanwix Autopark; treasurer—F. K. Wunderlich, Pennsylvania Railroad Co.; directors—E. J. Staubitz, Consulting Engineer; A. M. Crawford, Pennsylvania Railroad Co.; F. E. Leib, Copperweld Steel Co.; S. C. Stoehr, Jr., Bell Tel. Co.; R. W. Will, Hamburg Brothers, Inc.; E. W. Breisch, Union Switch & Signal Co.; L. J. Russ, Duquesne Light Co., and R. J. Ravas, Carnegie Institute of Technology.

Rocky Mountain

The May meeting of the chapter was held on the 22nd at the Ent AFB Officers Club with the evening's program sponsored by the Philco Corporation.

Frank Edwards, General Engineering Manager of Philco's Appliance Division, Philadelphia, discussed Philco's investigation of effects of atmospheric ionization on human behaviour. His vivid description of the medical and physiological applications of controlled ionization were of great interest to the group of about 50 members and guests present.

This meeting concluded the chapter's formal meetings for the season. The annual chapter picnic will be held during the summer.

Rome-Utica

The May 22nd meeting was reported in the *Rome Daily Sentinel* as follows:

"The electronic world of 1977—an era of automation, increasing production and employment, decreasing costs and hours of labor, and availability of more goods for more people—was described last night for members of the Armed Forces Communications and Electronics Association meeting for dinner at the Griffiss AFB Officers Club.

"Phillip E. Cunningham, color coordinator for the Northeast Region Radio Corp. of America, told the men that electronics, the fastest growing industry in the country today, will influence their lives, bring new comforts and benefits, broaden their knowledge and bring new strength to the nation's economy.

"The speaker revealed that the developments, devices and products that will be coming out of the research laboratories and off the engineers' drawing boards in the coming decades will make many of the present day wonders look like the Mayflower II. 'Even the next 20 years may produce enough startling changes to completely alter our present ways of life,' he said."

Col. Charles W. Gordon, USAF (Ret.), local manager for RCA, and past president of AFCEA's Scott-St. Louis Chapter, was the chairman for the evening and introduced the speaker.

San Juan

Kenneth M. Barbier, president of the Radio Corporation of Puerto Rico, was elected chapter president at the May 22nd meeting.

Other officers chosen during the annual election were: First vice president —Harry O. Compton, Puerto Rico Telephone Co.; second vice president—tied between Alfred C. Weed, Jr., and Capt. James D. Whitfield, USN (runoff to be determined at special Board meeting in the near future); secretary—Albert R. Crumley, Jr., Standard Electric Corporation of Puerto Rico; treasurer—Jorge N. Toledo, Radio Corporation of Puerto Rico.

Board of Directors: George Alich, Civil Aeronautics Administration; Ralph Quainton, U.S. Naval Communications; Capt. James Hollis, U. S. Army Signal Corps; Joaquin Gandia, Civil

***South Carolina**—Shown at the head table of the May 22nd meeting, held at the Charleston AFB Officers' Club, are, left to right: William O. Kiger, Southern Bell T&T Co., incoming chapter president; Mrs. W. I. Bull; Ralph Leader, Sales Manager, Radar Range Dept., Raytheon Company, guest speaker; Cdr. Harry C. Rodin, USN, retiring chapter president; Capt. W. I. Bull, Commander, Charleston Naval Shipyard; Mrs. Rodin, and Col. Hubert N. Sturdivant, Shaw AFB, incoming 1st vice president.*

Southern California—Shown here is a portion of the record attendance which marked the chapter's June 9th meeting at the Hotel Statler in Los Angeles. Featured speakers were John R. Moore, Autonetics Div., North American Aviation, Inc., and John Herrick, Space Technology Labs, Ramo-Wooldridge Corporation.

Aeronautics Administration, and Julio A. Fuentes, Radio Corporation of Puerto Rico.

Scott-St. Louis

Col. Wilbur W. Bailey, Chief of the Communications System Division, Directorate of Communications-Electronics, USAF, told the chapter's June meeting that, due to the development of nuclear power and jet propulsion weapons, the Air Force communication-electronics program will continue to absorb an increasing share of the Air Force budget. He pointed out that seven years ago the Air Force spent $150 million for communications-electronics equipment, the bulk of which covered ground equipment, whereas for the year beginning July 1, 1958, procurement funds for ground equipment alone totaled nearly $1 billion.

Colonel Bailey further said that the Air Force feels a "major technological breakthrough" in this equipment is required.

He mentioned radar as an area in which more progress must be made, since present techniques of increasing radar's power to increase its range further emphasize its inherent limitation—the line of sight characteristic. Increasing radar's power for range will be accompanied by a corresponding increase in its costs and problems of maintenance, he pointed out.

Forward scatter techniques in communications are valuable, he said, but they are still used for transmission of signals which have changed little "since the telephone, the teletypewriter and the facsimile device were invented."

In the long range view, the speaker pointed out, there are areas such as radar and scatter propagation in which increasing costs may only provide for "increasingly diminishing returns for the investment we will be required to make in terms of money, technical manpower, and radio frequencies."

South Carolina

Since the May 22nd meeting was annual "Ladies' Night," the chapter scheduled a special program for the occasion. Guest speaker was Ralph Leader, Radarange Sales Manager of the Raytheon Manufacturing Company, who discussed the Raytheon Radarange.

Mr. Leader's talk, not only was of interest to the ladies, but the technical aspects as well as the cooking marvels of the range were of interest to the men. At the conclusion of his program, Mr. Leader answered many questions on the Radarange from the audience.

The meeting took place at the Charleston Air Force Base Officers Club, with 124 members and guests in attendance. Following dinner, Cmdr. Harry Rodin, chapter president, introduced the guests and presented Capt. W. I. Bull, USN, Commander of the Charleston Naval Shipyard, who welcomed the ladies and spoke briefly of the advancement of electronics not only in national defense but in peacetime civilian use.

During the business session, the following new officers were elected for

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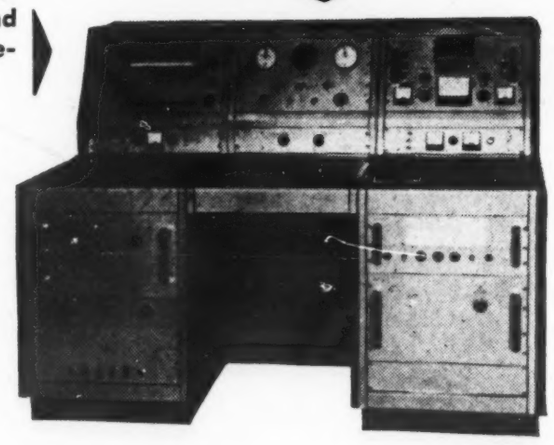

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Tokyo—Yokota Air Base was the scene of the chapter's April meeting which featured an Air Force program. Shown addressing the group is Col. Robert W. Dickerson, Commander, Far East AACS Region, whose topic was air traffic control.

1958-59: President—W. O. Kiger, South Carolina Traffic Supervisor, Southern Bell Tel. & Tel. Co.; first vice president—Col. H. N. Sturdivant, Commanding Officer, 8th Communications Group, Shaw Air Force Base; second vice president—E. D. Biggerstaff, Head Engineer, Electronics Division, Charleston Naval Shipyard; secretary-treasurer—F. L. Davis, South Carolina Staff Engineer, Southern Bell Tel. & Tel. Co; directors—Maj. Frank S. Barnes, Jr., Plant Superintendent, Rock Hill Tel. Co.; Capt. A. C. Krajnik, 727th A C & W Squadron, Myrtle Beach Air Force Base, and Capt. John H. Rains, Jr., Communications Officer of the 63rd TCW, Donaldson Air Force Base; national council members—W. O. Kiger and Col. H. N. Sturdivant.

Commander Rodin, under whose leadership the chapter had a record year of activity, was transferred to San Juan, P. R., in July to take over a new assignment as Industrial Manager, Tenth Naval District.

Southern California

The chapter's closing meeting of the season on June 9th was attended by over 300 members and their non-member guests. Featured speakers were John R. Moore, Vice President and General Manager, Autonetics Division, North American Aviation, Inc., and John Herrick, member of the staff, Space Technology Laboratories, Ramo-Wooldridge Corporation.

Mr. Moore spoke on "Factors Affecting Long Range Planning in the Defense Equipment Industry, Also Touching on General Space Vehicle Problems." He pointed out that complex defense products require an increasingly large ratio of scientists and engineers to factory workers, thus making the defense electronics industry far different from the consumer goods electronics industry. He further stated that in addition to complexity, there is an increase in the destructive efficiency of weapons to the point where defense requires a much smaller number of individual end items than in former years.

Mr. Herrick's subject was "Missiles—All Of them!" This was a fast moving informative narration-commentary on a series of colored slides of the entire defense missile family.

The annual election of officers was held during the business meeting. Those chosen were: president—John W. Inwood, Western Union Tele. Co.; first vice president—John W. Atwood, Hughes Aircraft; second vice president—Frank J. Shannon, Sr., Packard-Bell Electronics Corp.; secretary—David G. Soergel, Autonetics Div., North American Aviation, Inc.; treasurer—Ray E. Meyers, Lockheed Aircraft Corp.; directors—Richard Fuller, Bendix Radio; C. F. Horne, Convair; Loyd C. Sigmon, Radio Station KMPC; C. A. La Har, RCA; L. D. Callahan, Gilfillan Bros.; L. E. Daniels, Daniels Engineering Co.; John Byrne, Motorola; J. H. Goodrich, Pacific Tel. & Tel.; Richard B. Leng, Packard-Bell; James McLean, Hoffman Laboratories; Jack Warner, Jr., Warner Bros. Pictures, and T. L. McKnight, Pacific Automation Corp.; council members—C. F. Horne, Ray E. Meyers, Frank J. Shannon, Sr. and C. A. La Har.

Southern Connecticut

William H. Lyon, Chief Engineer of the SoundScriber Corporation in New Haven, presented a discussion on recording equipment at the chapter's May 22nd meeting.

Mr. Lyon described the latest developments in SoundScriber equipment and discussed types of magnetic recording media. After his talk, there was a demonstration of SoundScriber products.

Tokyo

The chapter met at Yokota Air Base on April 18th for an Air Force Program. Col. James E. Johnston, Commander of the base, was host for the occasion. Principal speaker was Col. Robert W. Dickerson, Commander Far East AACS Region, who discussed the air traffic control problem.

The June 20th meeting was held at the South Camp Drake Officers Club under the sponsorship of the Army. Highlights were a tour of the Army Command and Administrative Network Tape Relay Center and the PEN Broadcast facilities at Camp Drake, and showing of a film on the Pentomic Army.

New officers were elected for 1958-59 as follows: President—Capt. Frank A. Dingfelder, USN; first vice president—Col. John W. Crawford, USAF; second vice president—Frank Colonna, RCA; third vice president—Lt. Col. John M. Goodman, USA; treasurer—Lt. Col. Theodore K. Jennings, USAF; secretary—Cmdr. Harold B. Kirkham, USN.

Vacancies on the board of directors were filled as follows: Ben Fouts, DAC; Lt. Col. Robert Brewer, USAF, and Donald Hughes, Philco.

Members of the board of directors carried over from last year are as follows: Brig. Gen. Ned Sirmyer, USAF; Brig. Gen. Harold G. Hayes, USA; Col. A. R. Morley, USA; Col. Thew J. Ice, Jr., USAF; Capt. Donald I. Mathers, USN, and Paul Becker, DAC.

Washington

A reception in honor of the new officers and directors was held in the Ballroom of the Willard Hotel on June 13. Some 200 members and their wives were present.

This concluded the chapter's activities for the 1957-58 year. Regular luncheon meetings will be resumed in the fall.

Washington—John R. O'Brien of Hoffman Laboratories, Inc., who has been installed as president of the Washington Chapter for 1958-59.

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SINGLE SIDEBAND, *December, 1956* — A round-up of recent technical discoveries as presented by the Joint Technical Advisory Committee through its sub committee on Single Sideband techniques. This special study for the FCC points up the many advantages of single sideband.

FERRITES, *October, 1956* — This new group of solid state materials outmodes the intermittent "pulse" system of World War II radar. The ferrites allow simultaneous sending and receiving on a single microwave antenna; as well as full-power transmission in microwave ranges with reduced power loss and interference.

SOLID STATE ELECTRONICS, *December, 1955* — This issue heralds the arrival of a new epoch in radio electronics — the solid state electronics era. Defined and named with the birth of the transistor, this concerns the control and utilization of the electric magnetic and photic properties of solids. There are now whole new classes of electronic devices due to discoveries in this field.

SCATTER PROPAGATION, *October, 1955* — Here's radio history in the making. This issue presents practical application of a new principle in the fields of broadcasting and electronics. Thirty-five papers lay the foundation of a new means of communicating over long distances.

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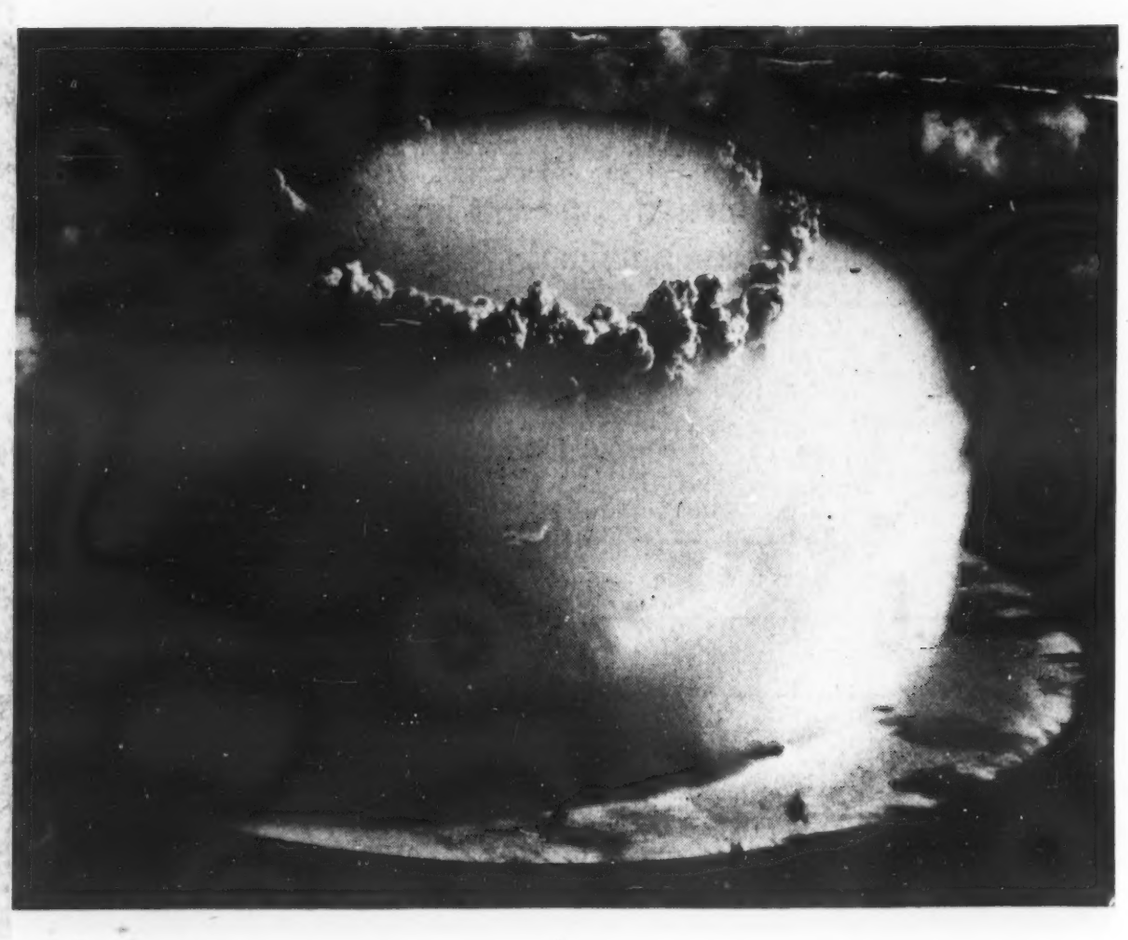

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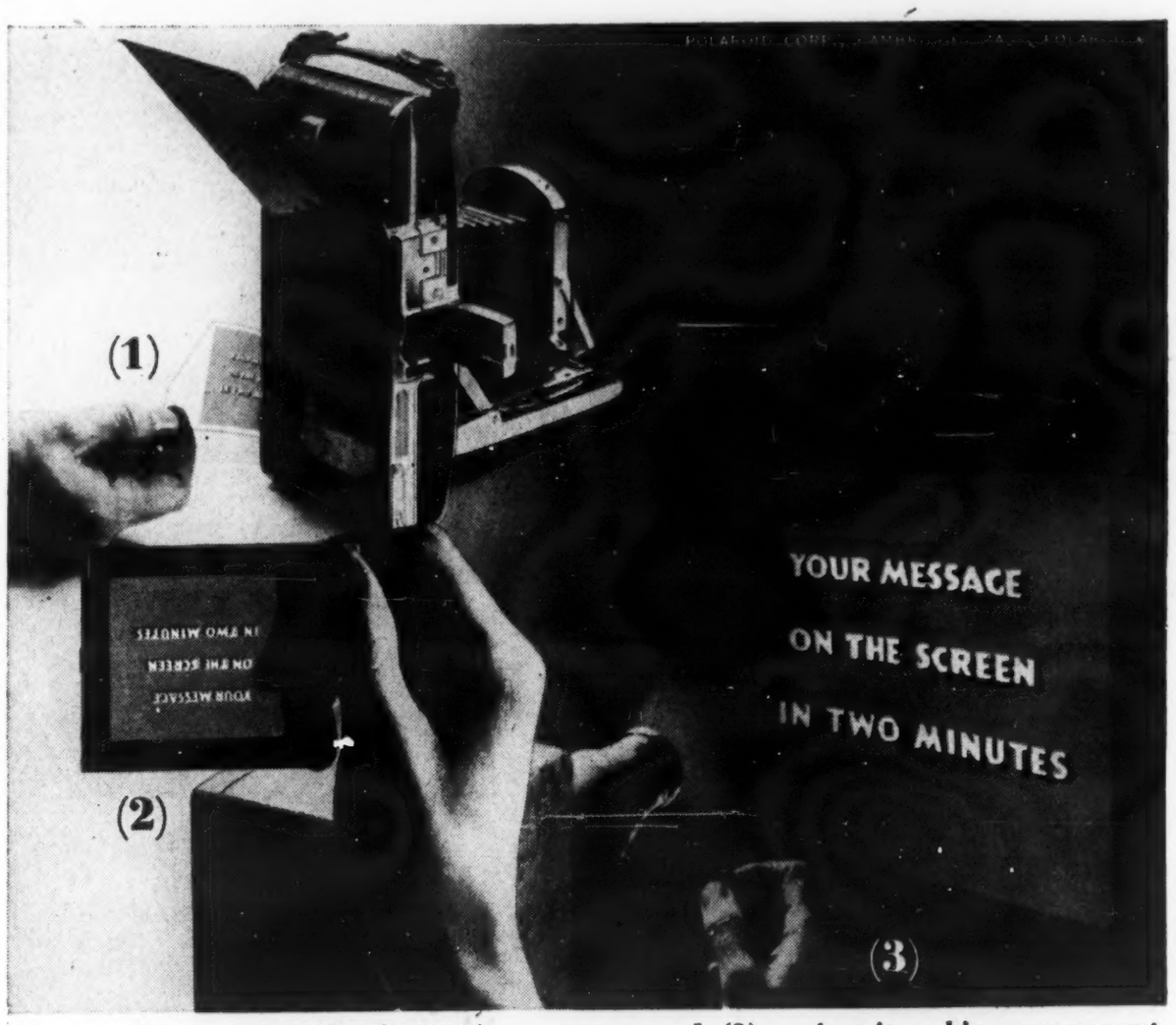

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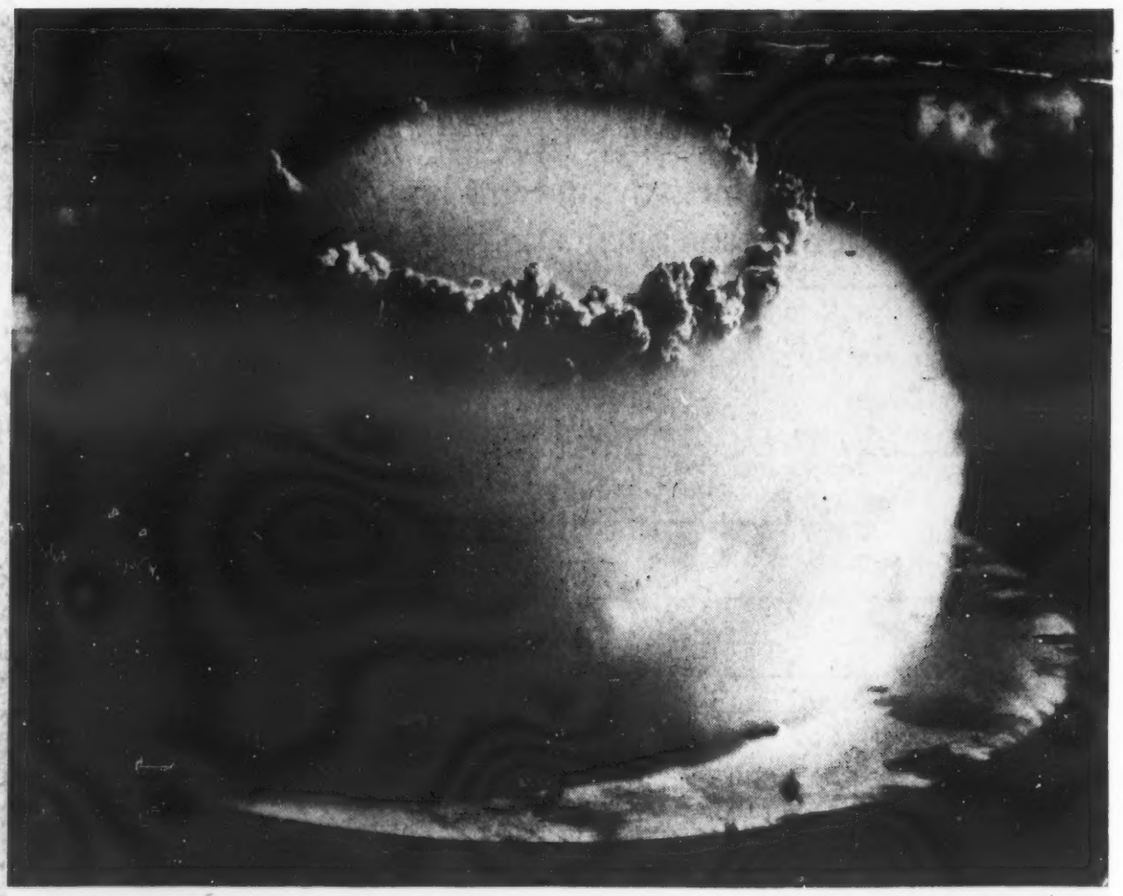

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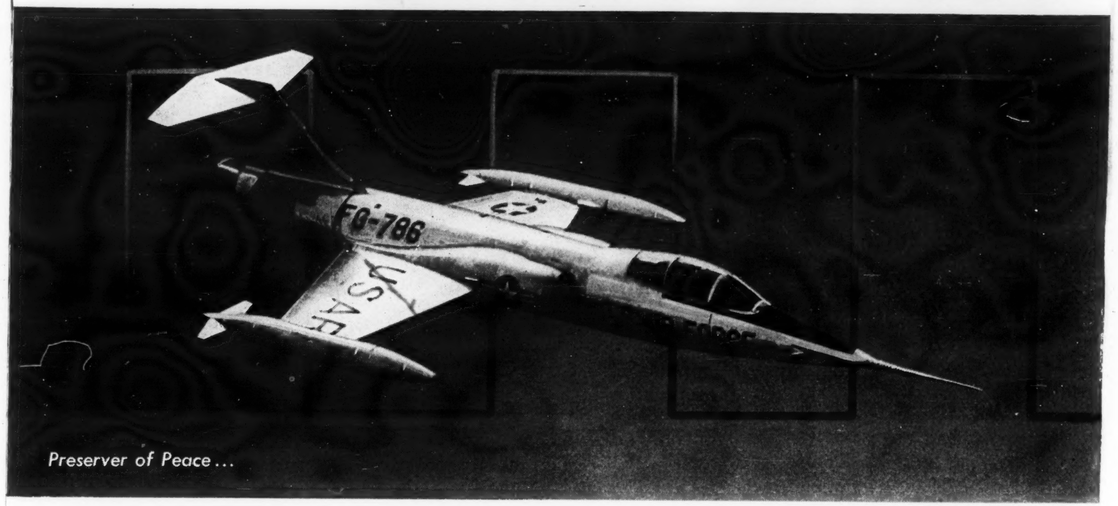

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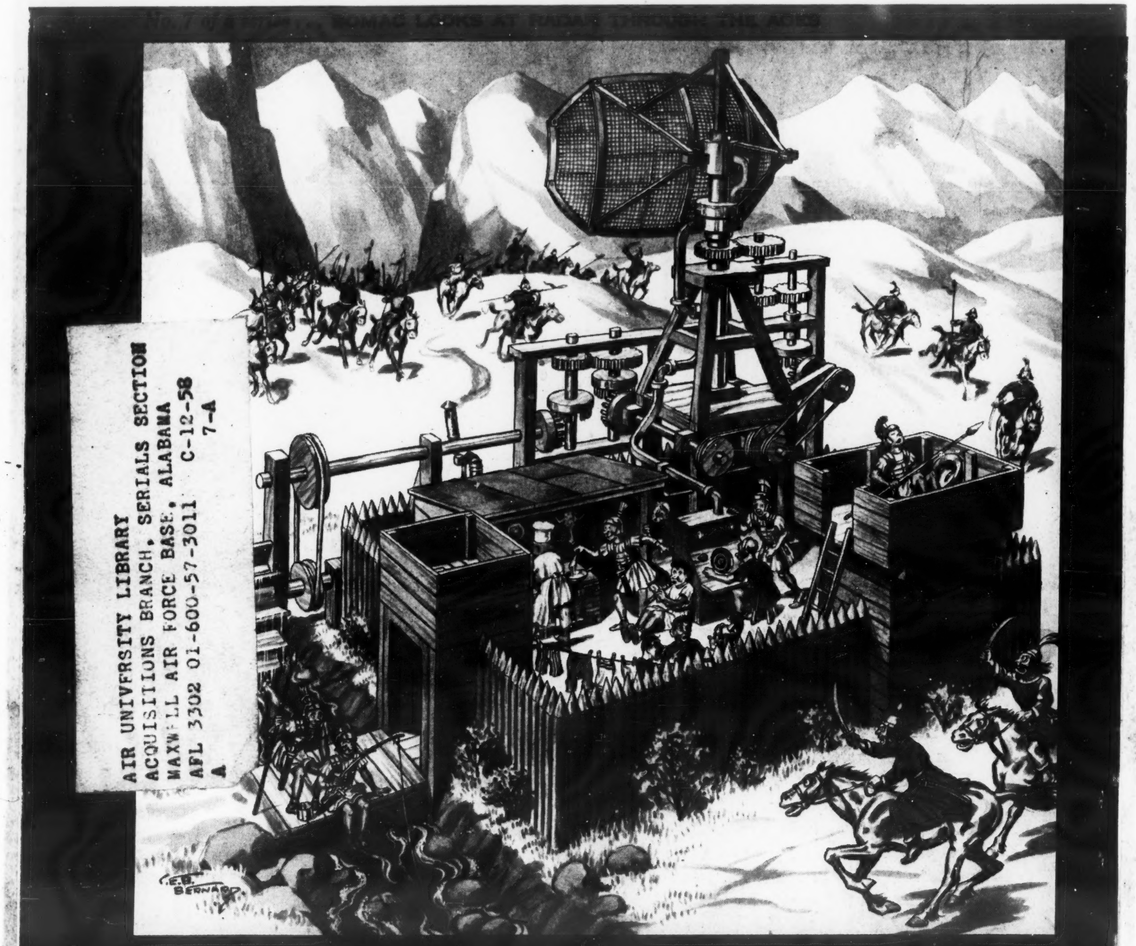
"Nosar" was a radar-like device that took advantage of a characteristic peculiar to the Huns: the fact that these hordes of unwashed barbarians gave off an aura so awesome it was capable of paralyzing a small dog at 300 feet. Thus, "nosar" — which could detect and record on its "nostrilloscope" the tell-tale scent of a single Hun at 10,000 yards — seemed the perfect defense weapon.*

Yet, here comes Attila — virtually at the gate of the garrison — and nary a pip shows on the "nostrilloscope"! The horrible Hun has played the dirtiest trick of all — he has ordered his troops to undergo a mass bathing! The garrison is doomed.

The Romans had some consolation, however — Attila and most of his troops fell victims to pneumonia long before they reached Rome. Sometimes, the bath is deadlier than the sword.



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